



A GREAT

BIG, COMPLETE

ERE at last is a complete, practical book on house wiring which you can use to do complete electrical jobs—from the smallest repairs to the wiring of an entire home. It shows you how to make electrical wiring diagrams and leads you, step by step, to all types of installation. Crystal-clear explanations and hundreds of photographs show you exactly how to do the actual work—splicing, taping, bending conduit, cutting cable, connecting fixtures, etc. At every point this great new book follows and shows you the application of the National Electrical Code, so you can be sure everything you do, from repairing an appliance to wiring a house, is fully in accord with Code requirements. After you have mastered the planning, the use of tools, and the Code provisions, the author shows you how to do complete wiring installations: a bungalow, a larger house, a garage and workshop, and a house being remodeled. Each job is complete, including the planning, the preparation of a bill of materials, all actual installation, and final testing and checking.

CIRCUITING AND PLAN READING

This section begins by taking all the mystery out of electric currents and the circuits built to carry them. It starts with the simplest possible case—the wiring of a single built—and then leads you dep by step to complete floor plans and wiring diagrams, connecting lights, switches, outlets, etc. Finally, it explains in detail how to make the actual installation observing your community's Code regulations.

TOOLS AND HOW TO USE THEM

The great value of this section is the complete, specific directions for using the ordinary electricist's tools. The author, a man who has had years of practical experience, shows you exactly how to make splices that hold, soldered joints that stay, smooth bends in conduit or cable, etc. He describes

every operation in complete detail, and explains all the tricks of the trade that assure you of turning out work of high professional standard

METHODS OF WIRING

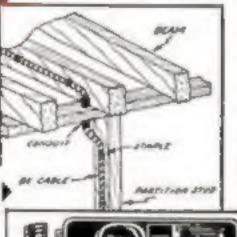
The four great chapters on methods of wiring constitute the most thorough, up-to-date and practical information now in print anywhere. All methods of wiring are discussed in detail, including open wiring on insulators, concealed knob-and-tube wiring, non-metallic sheathed cable wiring, wiring with armored BX cable, wiring in rigid conduit, and wiring for surface extensions. There is a complete, separate account of each of these methods, covering the type of installation for which it is best suited, its advantages and disadvantages its Code restrictions and requirements, the necessary supplies, and the methods of installation with fully illustrated explanations of all operations.

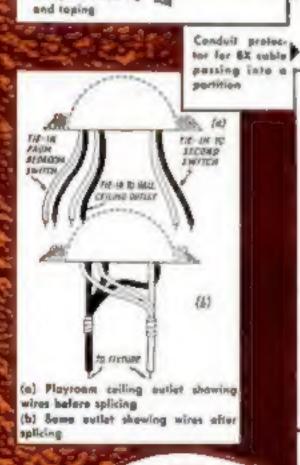
HOW TO WIRE A BUNGALOW

This is the first of the complete electrical installations that are fully described in this book. It starts from the very beginning, with the actual floor-plans of the bungalow and shows you how to decide upon the number and position of the lighting flatures to be installed the switches to control them, the receptacles for lamps in each room. The author shows you how to prepare a wiring plan, how to prepare a bill of materials, and how to carry out every step in the actual installation.

HOW TO WIRE A QNE-FAMILY HOUSE

In this chapter the "watts-per-sq, It," method of determining the number of outlets for general lighting purposes, is fully discussed by the author, and its application to the electrical needs in a full size, new house. An easy approach is made to wiring plans which require more than one branch lighting circuit, Making special provision for a small-appliance circuit is fully explained and illustrated.





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PRACTICAL RESIDENTIAL WIRING

By JOHN F. NOWAK

Every operation in house wiring—every method, every job, every step in doing the work yourself explained in plain English and illustrated by hundreds of vivid actual-job photographs

HOW TO WIRE A WORKSHOP

The great value of the detailed description of this complete project is that it intro-duces the use of wiring in rigid conduit. and also shows the manner of installing a and also shows the manner of installing a 3-wire. single-phase alternating-current service together with the use of an artificial ground. The workshop and garage nature of the project show you how to provide for portable workshop power tools. The complete explanations, profusely illustrated, cover every step from the planning of the service to the connection of the power units and lighting fixtures.

WINING A FINISHED HOUSE

Since the jobs described in earlier chapters were done on new houses, where the cable and wiring could be installed before the walls were plantered, this present chapter explains in full a complete electrical installation on a finished house. The methods are especially useful in house remodeling, and the author describes in detail an entire job, from the planning of the installation to patching holes in walls and ceilings, finishing the service wiring.

LIGHTING FIXTURES

The selection of lighting fistures that are up-to-date in design and in accord with the room is most important to the appear-ance of the home. Furthermore, there is often a choice between incandescent and fluorescent lighting. All this information is fully presented, together with full direc-lious for connecting and installing the Various types of fixtures.

SIGNALING SYSTEMS

in addition to wiring for lighting and power, the home contains signaling systems serving such devices as doorbells, door opener releases, annunciators and burglar alarms. Their circuits are independent of the light and power wiring, and must be installed separately. The author covers completely such systems, beginning with the basic elements, and covering every step in the planning installation, and repair of actual circuits.

TESTING AND TROUBLE-SHOOTING

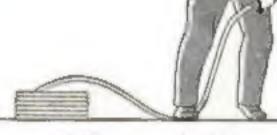
This great fund of handy information will prove its value to you time after time. It guarantees the safety of every job you do. It gives you the quickest and surest methods for checking any new in-stallation, and for locating troubles in any already-installed system that is not working properly it covers electric lighting power circuits and signaling systems thoroughly. With this information you can be confident of correcting any of the troubles you are likely to en-counter in a residential wiring system.

HOUSEHOLD ELECTRICAL APPLIANCES

Brought together within these pages are all the methods and practical suggestions from the long experience of a master-electrician in servicing and repairing household electrical appliances. The author discusses all the major classes of appliances and their characteristic troubles—lamps heaters storage batteries and motorized appliances. The specific troubles of this last group include motor troubles both electrical and mechanical. There are detailed directions, with clear "x-ray" pictures for trouble-shooting and repair.

GLOSSARY AND CODE TABLES

The final sections bring together, for instant reference, all the information about electrical installations in real-dences. The glossary gives you in plain, non-technical English the exact meaning of hundreds of terms, arranged in alphabetical order. The National Electrical Code tables summarise the provisions of the Code that apply to small-house wiring, and which have been explained throughout the book. From the first page to the last, this practical, brand-new to the last, this practical, brand-new book explains and illustrates every step in residential wiring so clearly and sim-ply that you can do all the work in accordance with professional standards.



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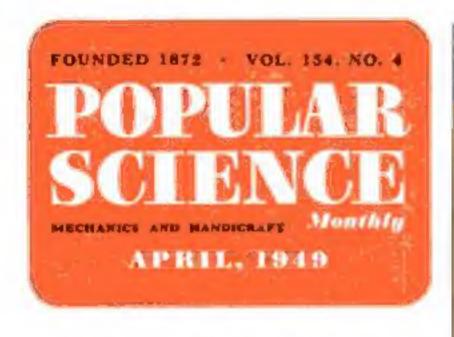
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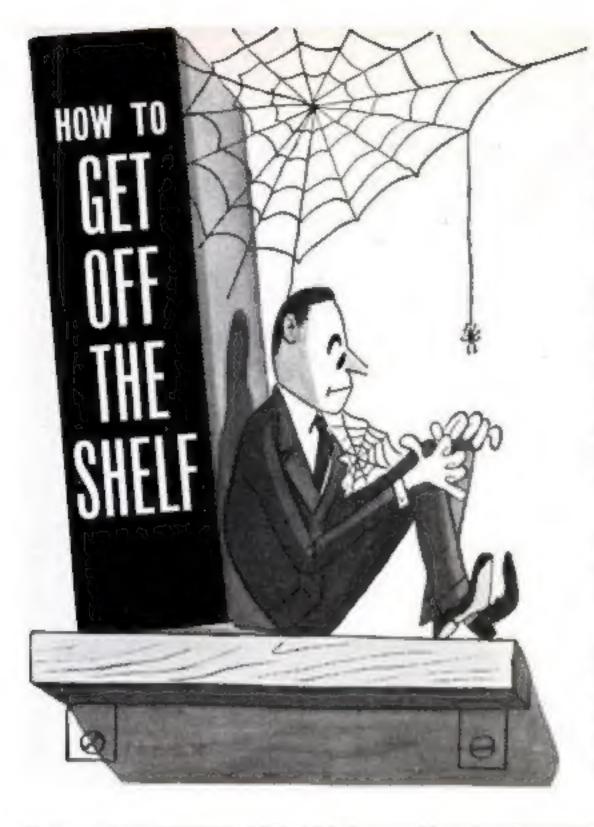
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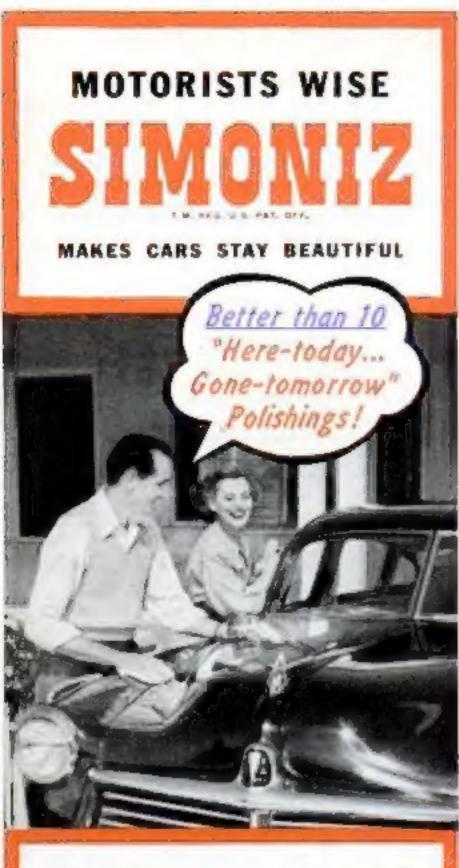
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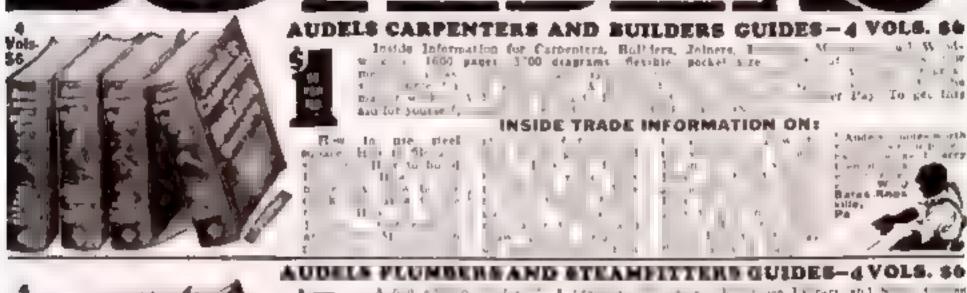
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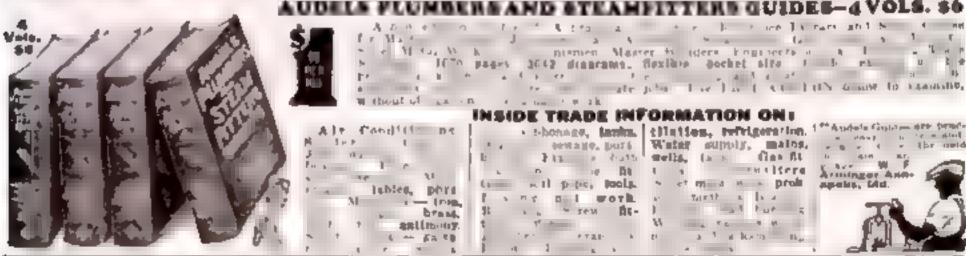
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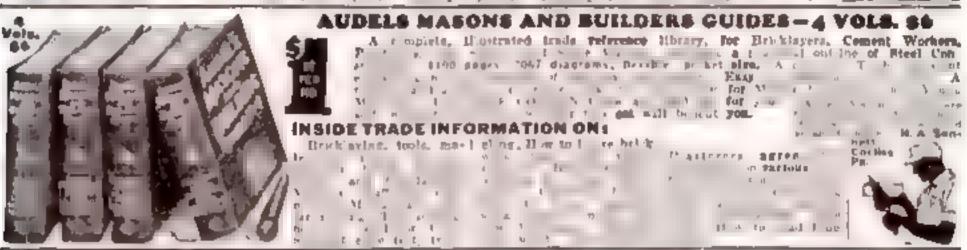
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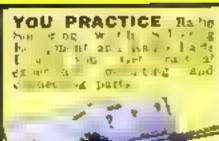
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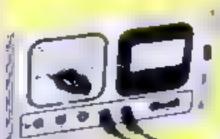
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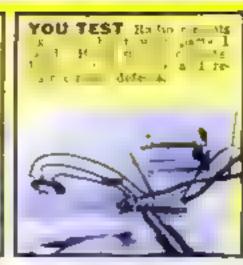
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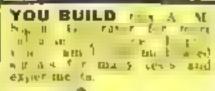
















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A patent gives the inventor the exclusive right to prevent others from making, using, or selling the invention claimed in the patent for a period of seventeen years.

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6 POPULAR SCIENCE

Letters



The Battle of Vivisection

Sir:

"The Truth About Experimental Animals" [PS, Feb. '49, p. 111] is one of the best editorial statements I have seen in a long time.

A. J. CARLSON, Ph.D., M.D. President

National Society for Medical Research Chicago, 1ll.

Sir:

In 1944, while in the Army, I suffered an attack of cerebro-spinal meningitis. Up to that time, the odds against recovery were about 10 to 1. However, under a treatment of sulpha and penicillin, I recovered, with little noticeable after effects.

My family and I are forever grateful to those animals who died that I might live.

DONALD P. HOLMES

Oakland, Calif.

Sir:

Just for the record, I should like to comment briefly on the editorial in your February number in which it is suggested that anti-vivisectionists find their motivation in the fact that "they hate humans."

I suppose you would be the first to agree that this idea is no more false than the rest

of your piece.

I shall not bother to list for you the great minds—from Burbank and Darrow to Louis Bromfield and Mark Twain—differing totally with your point of view. The fact that Twain belongs to the Nineteenth Century cannot mean much, surely—for if animal experimentation has created great good in the past century or so, then surely it must have been more valuable in Twain's day than it is now in terms of what lay before it to be accomplished.

Before a subcommittee of the Wisconsin General Assembly a couple of years ago, Dr. Meek of Wisconsin said this: "No agony is too acute to be visited upon an infinite number of animals if in the opinion of the least member of any medical faculty there is any chance of adding to the sum of human knowledge—and this without reference to the question of whether such addition is

INVENTORS

Patent laws encourage the development of inventions.

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The firm of McMorrow, Berman and Davidson is registered to practice before the United States Patent Office. Additionally it engages patent attorneys able to readily understand inventors' disclosures, to advise concerning patentability, and to prepare appropriate specifications and claims.

If an inventor believes he has an invention, a search of the most pertinent prior U. S. patents should be made and a report obtained relative to its patentability. Where such report indicates that the invention appears patentable, in order to secure protection, diligence should be exercised in making application for a patent.

Send for a copy of Patent Booklet entitled "How To Protect Your Invention." This booklet contains information on patent protection and procedure. You will also receive an "Invention Record" blank. This will be promptly forwarded to you upon request—no obligation.

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AT HOME-SPARE TIME-FULL TIME



likely to be of any practical value or not." It is that attitude. Sir-not the "slaying" of an unborn chick through boiling an eggwhich anti-vivisectionists oppose. . . .

The question, then, is why do you, like other proponents of animal experimentation, find it necessary to defend the practice by resort to arguments you know to be false?

C. E. RICHARD Managing Director

The National Anti-Vivisection Society Chicago, Ill.

Sir.

I have been bitterly opposed to the cruelties of vivisection upon dogs from knowing what suffering they have to endure in the vivisection laboratories, . . . I have affidavits from persons who have witnessed this cruelty.

When the public is enlightened on what actually happens to our dogs in the laboratories and that most of the time the dogs are not given any anesthetic, they will compel our legislature to enact a bill outlawing this useless form of cruelty. . . .

JAMES H. CRUIKSHANK

New York, N. Y.

Sire

I am definitely not an anti-vivisectionist, but I am dotingly fond of my dog whose company I have enjoyed for fifteen years.

Today that dog is very ill, and I have been advised to have her destroyed in a humane manner. Such a decision is hard for me to make, and since reading your editorial, I feel much better about it all. A "chicken heart" is detrimental although understandable in cases of dog-lovers for their own pets to whom they have become attached, but to carry over such obviously foolish love to every dog so as to interfere with the science of life and its ever-present mysteries is an unpardonable sin.

I heartily agree with you, Mr. Githens, and I extend you my deepest respect for all your wisdom editorially rendered.

JACK SKALICKY

Cedar Rapids, Ia.

Sir:

We happen to be two of the crazy people this Cithens refers to, but it also happens we know a great deal about some of these experiments and a great deal more about the subject than he. . . .

We are just crazy enough to cancel our

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The inventor should date and sign his disclosure and have it witnessed by two or more persons who are capable of understanding his invention. The disclosure should then be mailed to the registered patent attorney or agent whom he

selects to assist him. The disclosure should be accompanied by a letter authorizing the patent attorney or agent to conduct a preliminary search among previously granted U. S. patents for similar types of invention. The patent attorney or agent then prepares a report of the probable patentability of the invention and recommends the further course the inventor should take, provided the report indicates possible patentability.

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MRS. FRANCIS PERRY

Chicago, Ill.

Sir:

I am a dog lover, but I say "bravo" for writing the article, "The Truth About Experimental Animals." It is shameful that in this country, and in this age, we allow science to be seriously hampered by a powerful organization of "sick people," so-called lovers of dogs.

EDNA M. DUBUIS

Bar Harbor, Me.

Sir:

My husband has been a chronic reader of your magazine for many years, but after reading your personal plug for an article upholding vivisection, he says he is through with it for good. Not that we are anti-vivisectionists. We heartily approve of it for those who commit rape and murder, all Communists and quite a few New Dealers.

This damnable outrage against helpless animals will be outlawed one of these days regardless of how many "blue babies" turn a deeper indigo. Better that they turn blue than grow up and turn yellow, championing such a cowardly, cruel thing as vivisection.

MRS. VERNON STONE

Roosevelt, N. Y.

Sir:

This is an idea I've had for some time as to how we may combat the menace of anti-vivisectionists. Children just naturally love animals, and they should see educational movies showing how humanely the doctors and laboratories treat their little furry friends and how they are indeed a friend to man by saving so many people's lives . . .

An educated public will start with an

educated school child.

SARA ORTGIER

Bell, Cahf,

Everything's Up to Pate in Denmark

Sir:

In the December issue, in the column "I'd Like to See Them Make" on page 165, Mr. H. M. Hartery would like to see them make a "com-operated electric shaver." At-



ø.



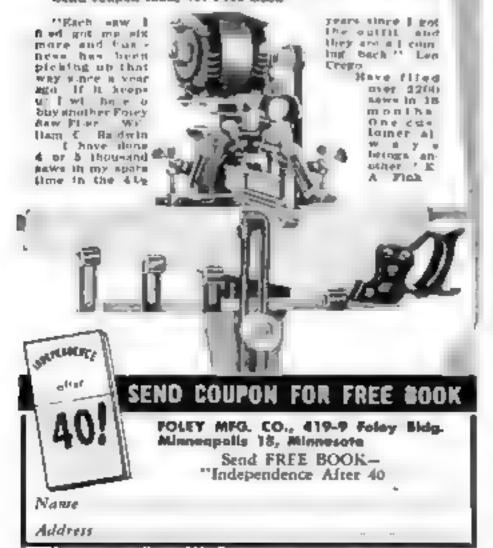
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hagen. At the Central Railway Station you can try one of them. They have been there for more than a year.

In an old issue, I've seen that somebody would like to see a coin-operated typewriter. In the same station there is also one of these. It has been there for many years.

So, you see, we are not very far behind in Copenhagen! . . .

GUNNAR MORTENSEN

Copenhagen, Denmark

Jack-of-All-Trades Horsepower?

Su:

The article on page 156 of the December issue, "How to get along when the power goes off," gave me an idea you may be interested in. It is using one motor for several jobs, and although the subject is often brought up in conversation among farmers, the farm machinery companies have never suggested it.

Many farmers have equipment that has a large motor, and they use this motor only two to four weeks a year. For example, the motor on the combine, hay-baler, corn picker, and field chopper. Why can't they buy just one motor and change it to the various pieces of machinery as the season progresses? And then they could also use it in the winter on the hammer mill or corn sheller.

RICHARD HABY

St. Louis, Mo.

frunt Those Bairs

Sir:

In your excellent cover of the February issue I noticed one glaring maccuracy. After considerable difficulty I ascertained that your illustration shows only 205 lines instead of the actual 525 found on the television picture.

Tutl and tut again Surs!

ROBERT J. BECKER, JR.

Kirkwood, Mo.

Tuts to you, too. Didn't you also notice that the man's eyebrow has two hairs too many! Seriously, however, no picture printed in two dimensions can be more than a representation of the original object. Since it would have been impossible to reproduce all 525 lines, we simply used a special half-tone screen to get the effect of television.

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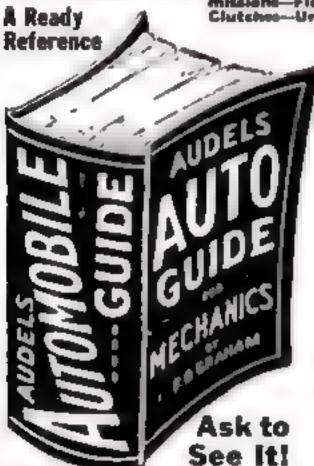
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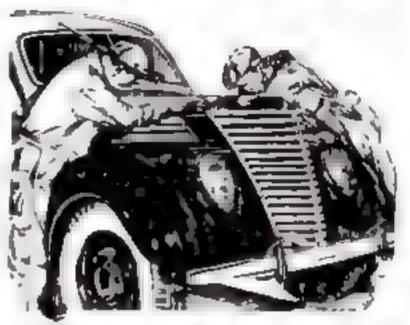
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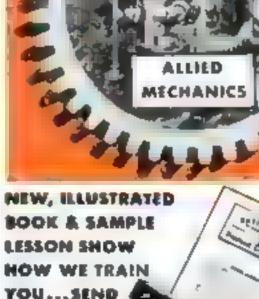
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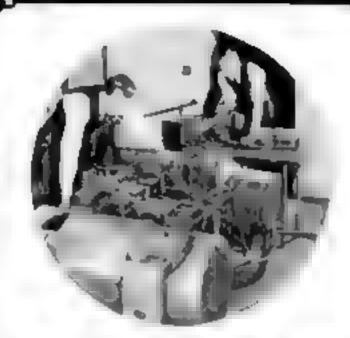
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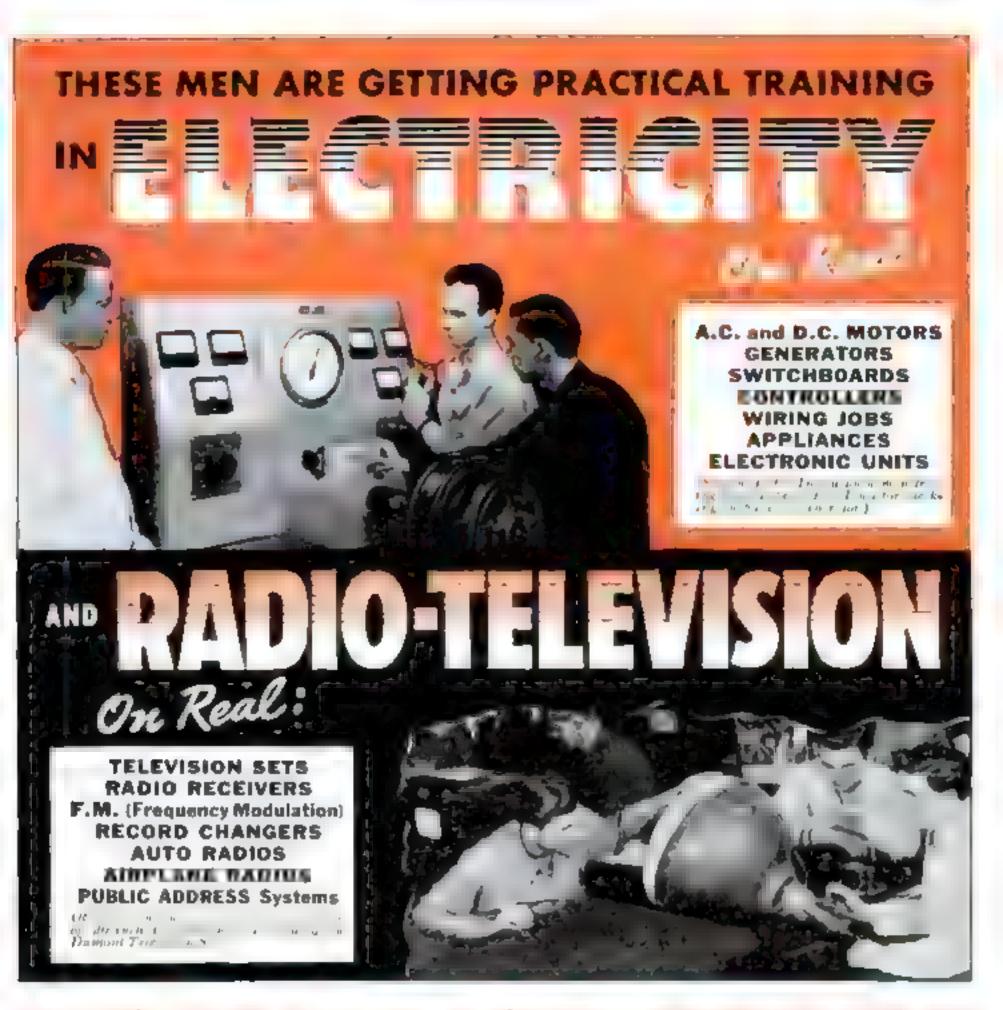
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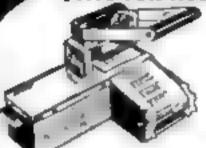
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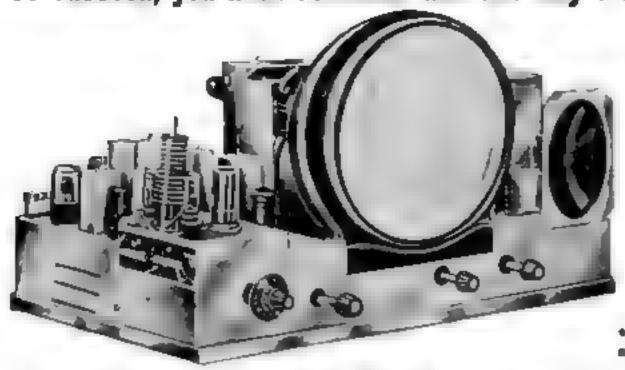
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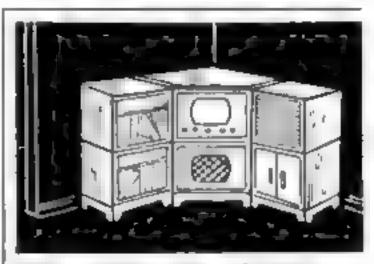
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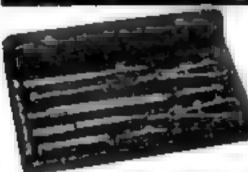
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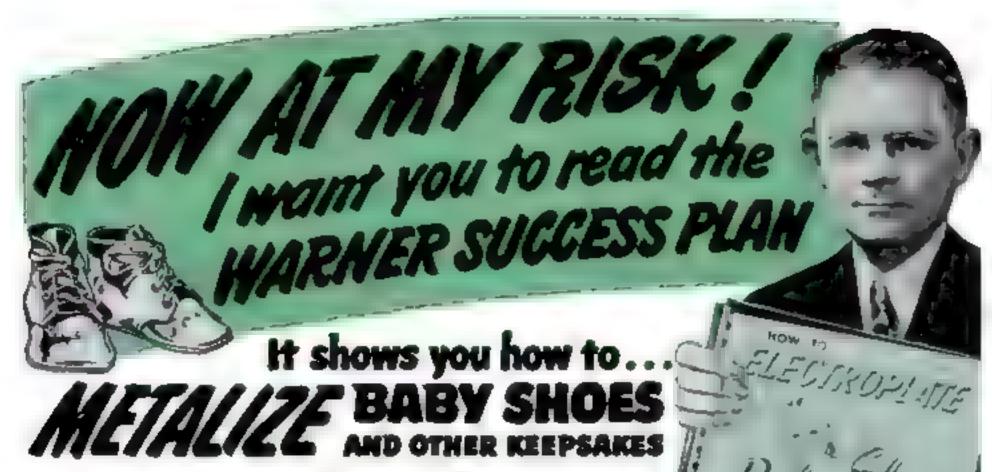


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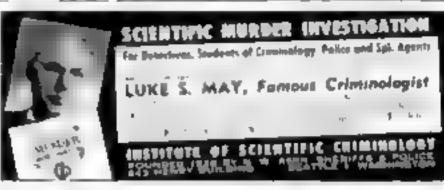
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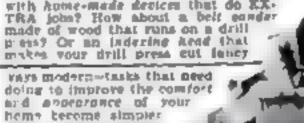
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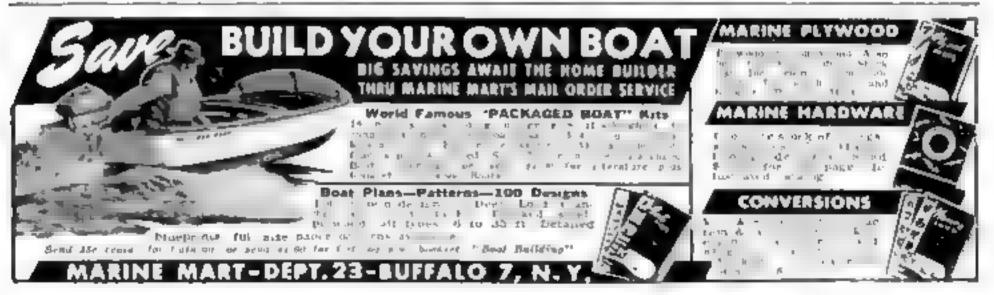
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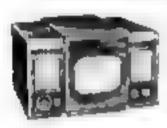


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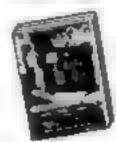
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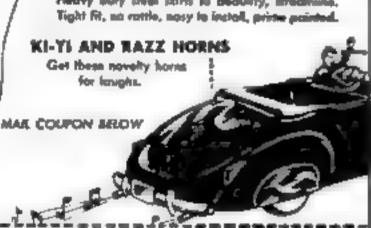
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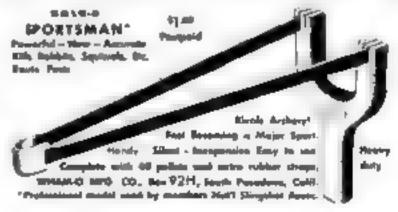
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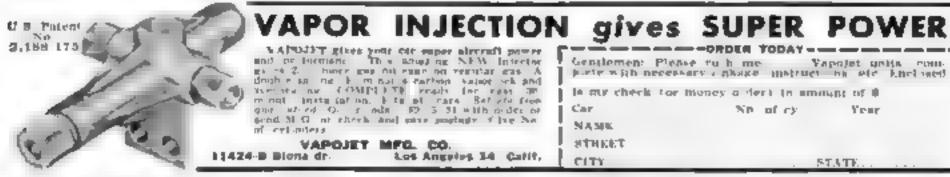


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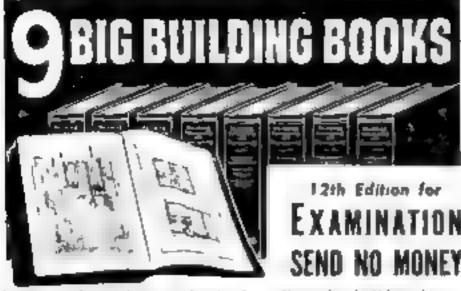
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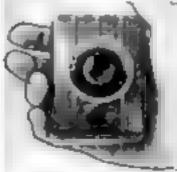
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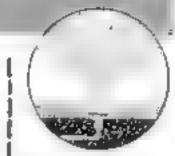
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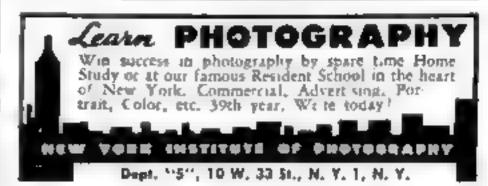
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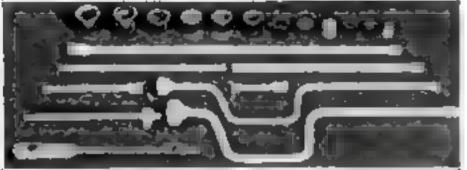


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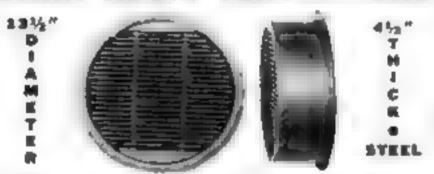
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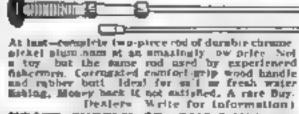
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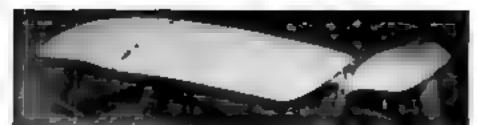
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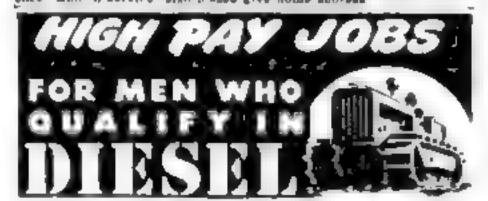
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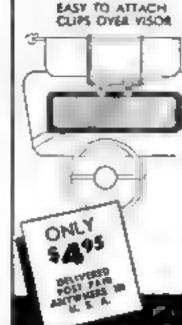


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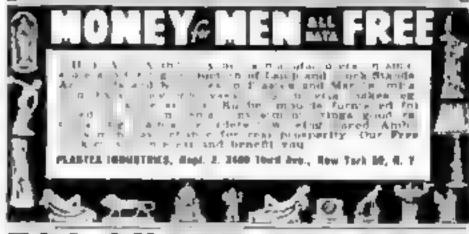


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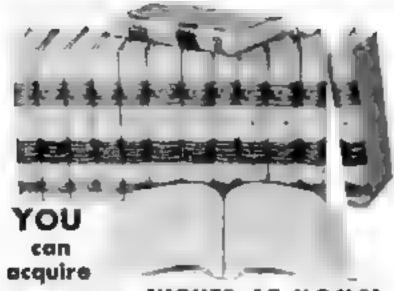
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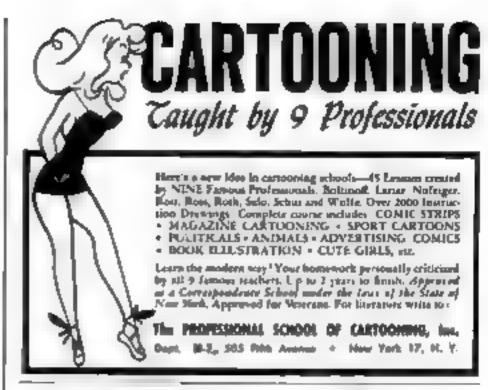
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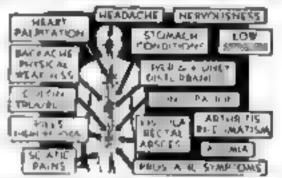
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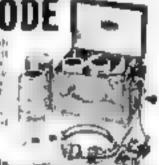
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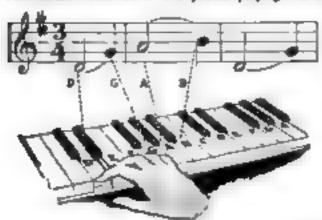
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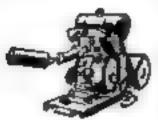
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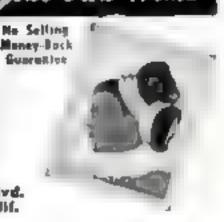


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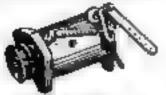
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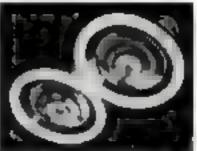
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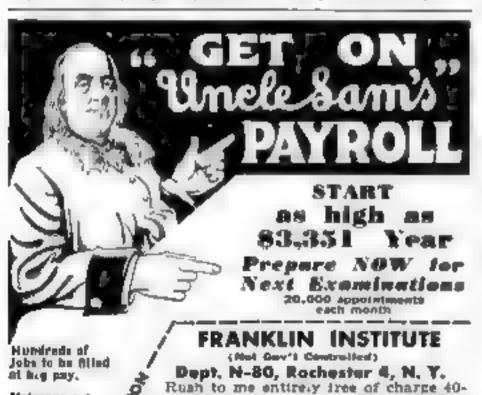
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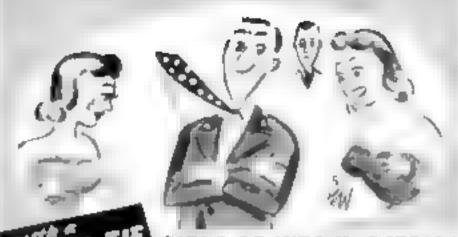


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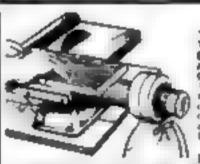
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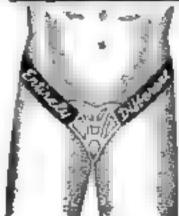
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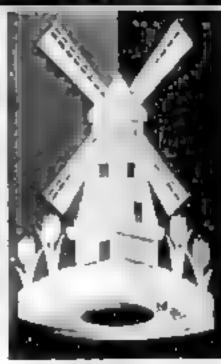
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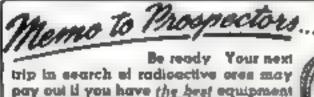
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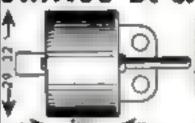
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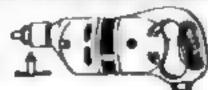
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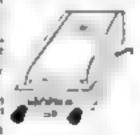
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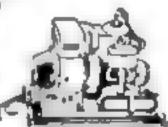
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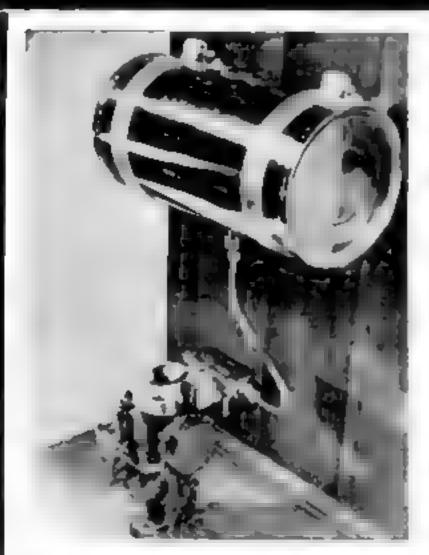
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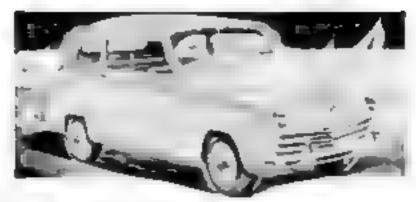
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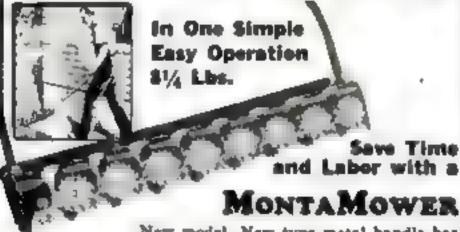
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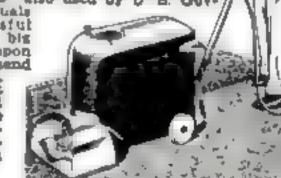
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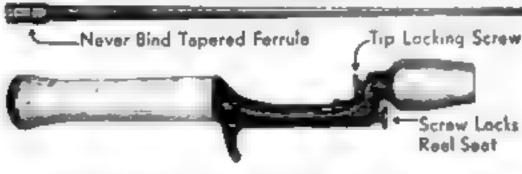


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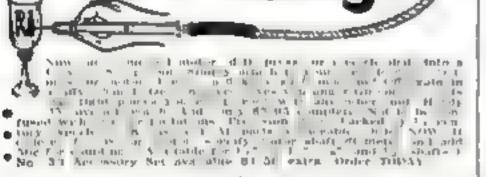
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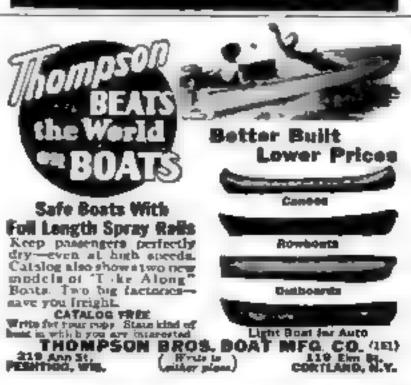


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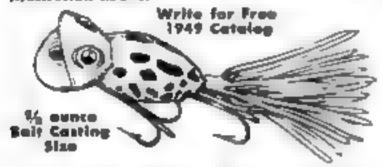
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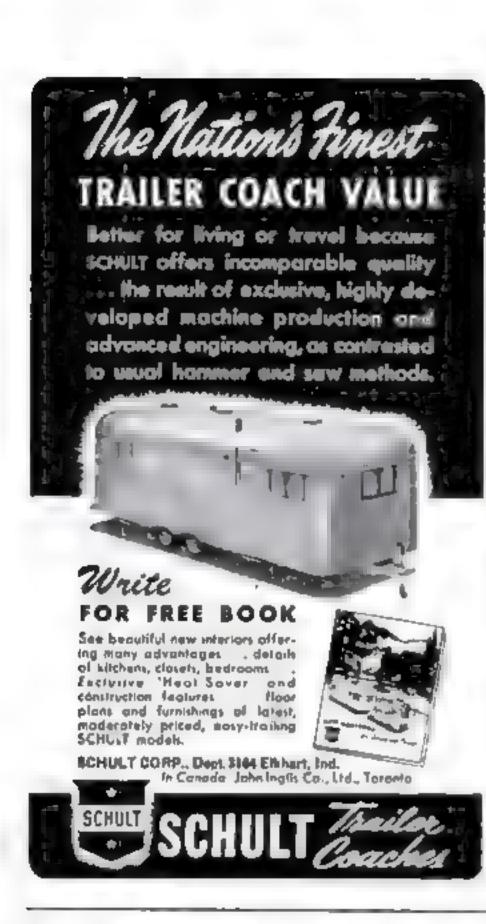
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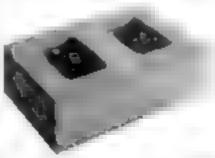
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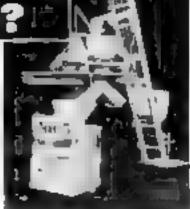


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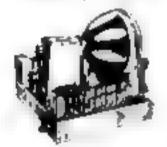
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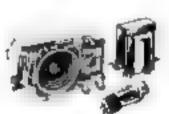
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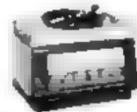


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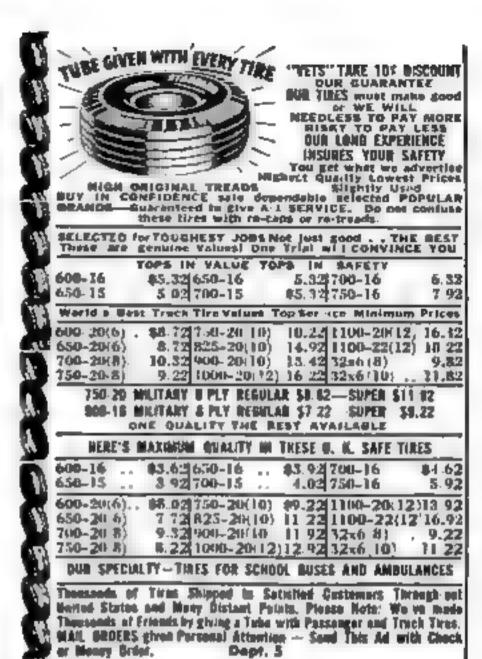
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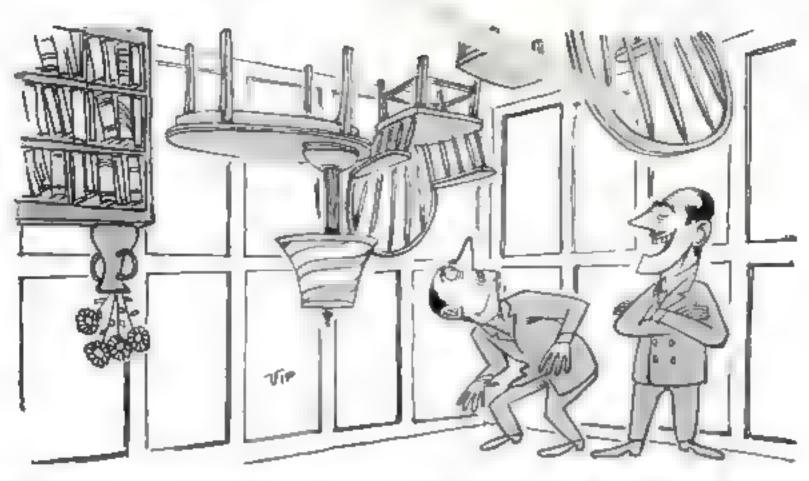


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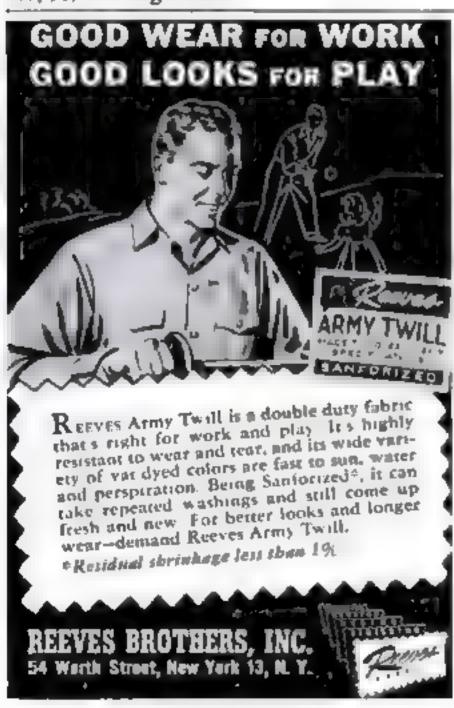
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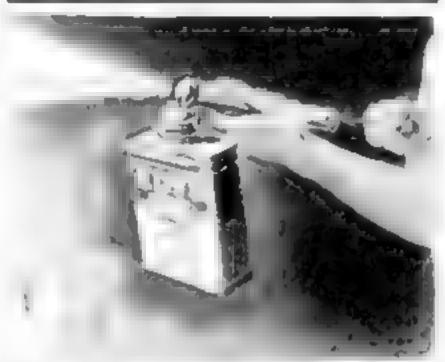
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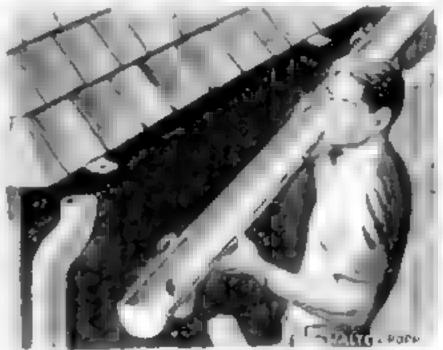


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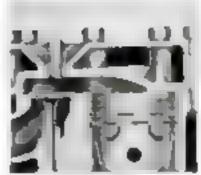
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of advancements in
basic design—both are
truly new. New "EquaFlo" Cooling System,
"Deep-Breath" Mani-



Ford "Fower-Dome" Combustion Chamber

folding, "Power-Dome" Combustion Chambers and improved lubrication all contribute to Ford's feeling of responsiveness.

Ford offers new economy, too; up to 10% savings in gas—up to 25% with Ford's smooth new automatic Overdrive, optional at extra cost.

And remember, only Ford in its field gives you this power choice of new V-8 or new Six!



Free...



YOUR 1949 PHOTOGRAPHIC CATALOG

OVER 1000 ILLUSTRATIONS—descriptions and prices of more than 1700 pieces of photographic equipment are included in Montgomery Ward's big, new Photographic Catalog.

THE NEWEST IN STILL CAMERAS— the sensational new Land camera that gives you a finished print just 60 seconds after you enap the shutlet! The new Boll & Howell Foton automatic 35 mm. (takes up to six pictures a second): the new low-priced Balsey miniature with twin lens reflex focusing; and many others.

THE LATEST IN MOVIE CAMERAS—the new Cine Koolik Special II (approaches the capacity of professional movie cameras), the new De Jur 8 mm. with Fade-Matic control, plus Wards new complete line of sound equipment.

NEW ACCESSORIES—the latest still projectors, new emergers, and lighting equipment. In this section you'll find everything to help you get the most from your photographic hobby.

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Contrated, the seem	a as printed (about May 1).
Name.	
	(PRINT plainly)
Street Address	
or Box.	

I'd like to see them make . . .



Wheelbarrow bodies that had the bolt or rivet heads flush with the inside. Then the shovel wouldn't be constantly catching on the heads when you shovel out sand or cement.—Lowell P. Amos, Toledo, O.



Kitchen attachments that could be chucked in an electric hand drill. A set of such accessories would convert any drill into a mechanical bester and mixer.—Eric St. Clair, Richmond, Calif

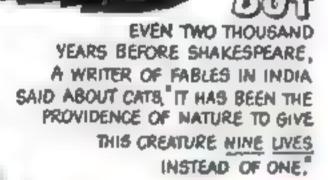


Luminous deals on combination locks. If the numbers and pointer would glow in the dark, it would save time not only at night but when used on lockers located in dimly lighted places.

—John P. Bayer, Batavia, O.

he 9 lives of a cat

MENTIONS THE "NINE LIVES" OF A CAT IN "ROMEO AND JULIET" TYBALT: WHAT WOULDST THOU HAVE WITH ME?" MERCUTIO: "GOOD KING OF CATS. NOTHING BUT ONE OF YOUR NINE LIVES"



THE FLASHLIGHT BATTERY WITH "NINE LIVES"

between uses



IS THE CAT'S ABILITY TO BOUNCE BACK. HE'S TOUGH AND HARD TO LICK. "EVEREADY" BATTERIES HAVE THE SAME SORT OF BOUNCE BACK! THEY RECOVER POWER BETWEEN USES ... LAST LONGER! THAT'S WHY THEY'RE CALLED THE BATTERIES

THE ORIGIN

OF THE SAYING

WITH "NINE LIVES."

"Everoads," "Nine Lives," and the cat symbol are trade-wards of

NATIONAL CARBON COMPANY, INC. 30 East 42od Street, New York 17, N. Y. Unit of Union Carbide III and Carbon Corporation



"Inside story" of a bigger, brighter picture on your television screen

The screen on which you usually see television is the face of an electron tube—on which electrons "paint" pictures in motion.

And the size of the picture, unless projected, is determined by the size of the tube.

Working to give you bigger, brighter pictures, RCA engineers and scientists developed a new way to make large, direct-view television tubes. They found a method of "welding" large areas of glass and metal... while keeping a vacuum-tight seal!

Using this development—ideally suited to mass production methods—RCA can now build television tubes of light, tough metal... using polished glass for the face, or "screen."

An achievement of research
Development of this new television tube continues basic tel-

evision research which began at RCA Laboratories. Such leadership in science and engineering adds value beyond price to any product or service of RCA and RCA Victor.

Examples of the newest advances in radio, television, and electronics—in action—may be seen at RCA Exhibition Hall, 36 West 49th Street, N. Y. Admission is free. Radio Corporation of America, Rudio City, N. Y. 20.



RADIO CORPORATION of AMERICA

World Leader in Radio - First in Television



THE men who have to fix them have not been exactly happy about the new cars. The stylists and designers have squeezed the engine room so tight that a minor adjustment has become a mechanical and athletic project.

Some owners are reportedly disillusioned about their sleek, new chariots. Bodies, swollen to tenderness, rupture with alarming ease when exposed to the harsh realities of roads and parking lots. Insurance companies and garages have raised their rates.

The automobile industry points proudly to the fact that today's lowest-priced cars carry more people more miles with more power and comfort than yesterday's medium-priced cars. But it is also true that today's lowest prices are up to yesterday's middle bracket. And there is no longer any such thing as low-cost automobile ownership.

The new cars described in this and recent issues are the first, small sign that the industry recognizes realities beyond easy money. The reality that cars must be made for use. That they are not going to be parked in the middle of a five-acre field, or driven only on lonely roads. That they are going to be bumped, scraped, and scratched even with the most careful driving. That men with usual-sized heads and hands will have to work on them.

Perhaps truly people-proof cars, short of a cushioned light tank, are impossible. But this particular new-car owner is getting a little tired of listening to manufacturing v.p.'s talks lightly of the safety value of "crumple effect" in swollen sheet steel—at \$165 per crump

And as a stockholder in this country, in the economy of which the automobile is so important, I am happy to note the first steps toward utility and a lower total cost of automobile ownership

Peny Githrus

Don't let a rusty radiator take you for a costly ride



Clean out rust with

DU PONT COOLING SYSTEM CLEANSER

Get rid of winter's accumulation of rust, scale and scum . . . avoid damage caused by overheating. Just pour a can of DU PONT CLEANSER into your radiator, run the engine 30 minutes or more, and drain. It dissolves rust—cleans thoroughly—improves the engine performance. It's eafe, sure and easy to use.

Keep out rust with

DU PONT ACID AND RUST INHIBITOR

After cleaning out the radiator, you can keep it free from rust all season by pouring in a can of DU PONT ACID AND RUST INHIBITOR. It retards rust formation, and keeps out acid, too.

Avoid radiator leaks with

DU PONT COOLING SYSTEM SEALER

You can stop leaks quickly and securely—and help to prevent radiator leaks in the future—by pouring in DU PONT COOLING SYSTEM SEALER. It will not clog the radiator or harm hose or metal parts.

Rust-clogged radiators cause overheating, trouble and expense



Better Things for Better Living
... Through Chamistry



Stairway to Atomic Industry...

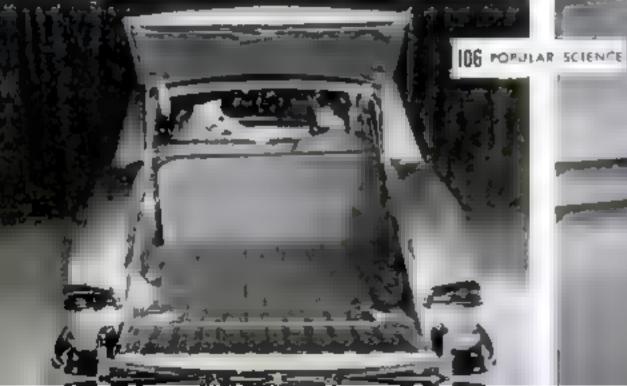
Here giant steps are really made for a giant a furnace that will work like the sum. For this is the found drow of the new atomic pile at Brookhaven National Lal oratory (story on p. 121), a nearant-and-graphite block encased in a 40 foot cube of concrete about six feet thick. The columns cast in step design represent the biggest poin. I 486 cir. yd. of concrete, of the \$21,600,000 program.



A farm family can use the new utility car both as a Sunday sedan and a workaday light truck.

Back seat is uprught a normal sed or postion in this yield helow threat it some thank With tail gate coosed the sedan has a st wigo space 4 ft 5 ir long belond the upright sent

Folding forward of rear seat can be dire by drive will ut bearing los place. Here he is pulling terms and the laste of the same went swings lite place a just sack of front sen-





Double-Buty Sedan Starts Utility Trem

It looks like a four-door sedan but costs

less and will also do the work of a truck.

By Devon Francis

Photos by W. W. Morris and John France

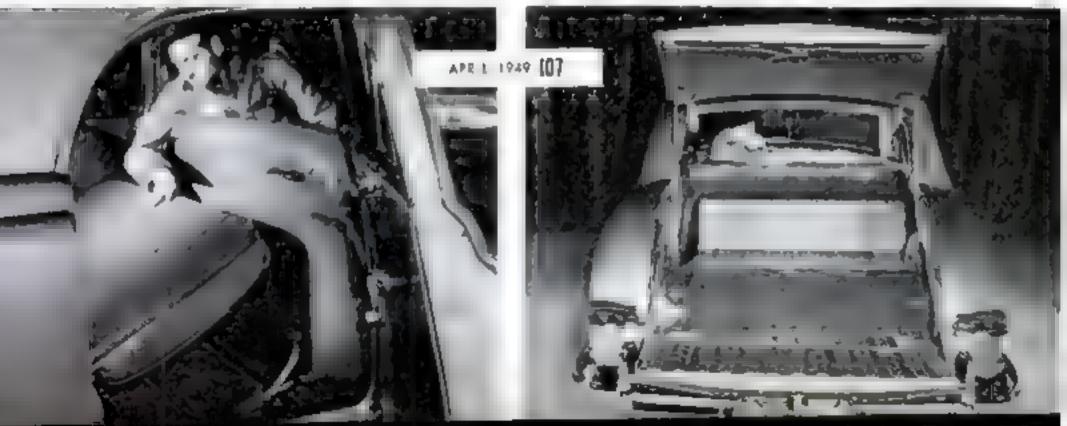
O NE day last summer workmen in the experimental shop of the Kaiser-Frazer Corporation at Willow Run, Mich., walked calmly up to a perfectly good Kaiser sedan and hacked out the back of the body. This was the start of a project personally originated by Henry J., himself, for good personal and business reasons.

Late last month, the company announced a new model that is really a new type of automobile: a utility sedan. It is designed to look like a four-door sedan, and work like a light truck or station wagon.

Back of rear seat folds forward next, swingorg down flat against our floor. Back seat can be removed entirely by unfastening four bolts, adding about 11 eq. ft. of carrying capacity But it is a couple of jumps ahead of the familiar station wagon. It can be changed from standard six-passenger sedan into truck in a few seconds, literally with a twist of the wrist. And it will cost a lot less than a station wagon, traditionally hundreds of dollars higher than the sedan of its line.

In fact, the Kaiser Traveler, as the utility car is known, will deliver for less than the standard sedan. The Vagabond, a plush version, glossy with genuine leather and chrome, is priced for the luxury trade. But the Traveler is the big news, with its emphasis on utility and lower cost. It is designed for families that need two kinds of transportation but want to buy only one car.

With rear seat entirely folded away, capacity is now 83.7 cu. ft. Cargo area is 6 ft. 8 in. long with tail gate closed, 46 in. wide between the rear-wheel wells. Mountain height is 30 in





Like many revolutionary ideas, the one behind the Kaiser utility car is simple. In essence, the designers have opened up the back end of a sedan, hinged it for access, and contrived fittings for the rear seat so it can be folded forward to make a flat floor. This provides a cargo space nine feet long, with tail gate down, and almost four feet wide at its narrowest point, between the wheels.

And like all simple ideas, it wasn't so easy to work out.

This idea began with a beef from the boss. Henry J. Kaiser had been driving a station wagon around his place near Lake Tahoe in the California Sierra. He found it hard to ride as a passenger car, hard to use as a truck. To haul anything, seats had to be wrestled out bodily. Maintenance was high. It squeaked and rattled. It was drafty. He didn't like it. Neither did Mrs. Kaiser. That settled it. A new kind of a car would have to be designed.

On a July day, 1948, Henry Kaiser telephoned his son Edgar, vice president and general manager of Kaiser-Frazer, at Willow Run.

"I've got an idea," announced the chairman of the board, typically without preface, He expounded on it, "Come on out,"

Edgar Kaiser and Dean Hammond, the company's chief engineer, met with Henry in an eleventh-floor office of the Kaiser Building in Oakland, Henry gave them the pitch. They talked. They began calling their creation a "utility vehicle" before they knew what it was going to look like. What they were after was a car that would do a station wagon's work and yet not be compromised as a regular sedan.

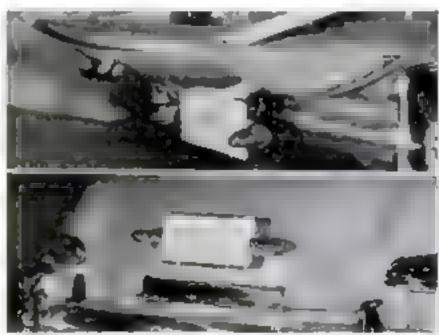
"The best way to get at this is to look at a car," said Henry Kaiser finally, "Let's go down to the garage."

They took the elevator downstairs, and on one of the company's standard sedans began drawing lines in the dust with their fingers. The cut on the body could be made here. The hinges might go there. Of course, something would have to be done with the rear seat so it need never be lifted.



Simple, inexpensive bracket holds the utility car's license plate vertical whether tail gate is up or down. When the gate is lowered (upper right), plate is pulled down by hand. When

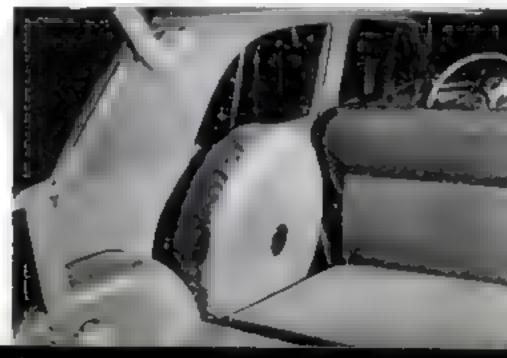
T handle (below) gives lever a for choose box or extra-heavy lower deck hid. Lower deck is 24 by 45 in. When opened, it's 24 in off ground with rear springs at a rmal extension.

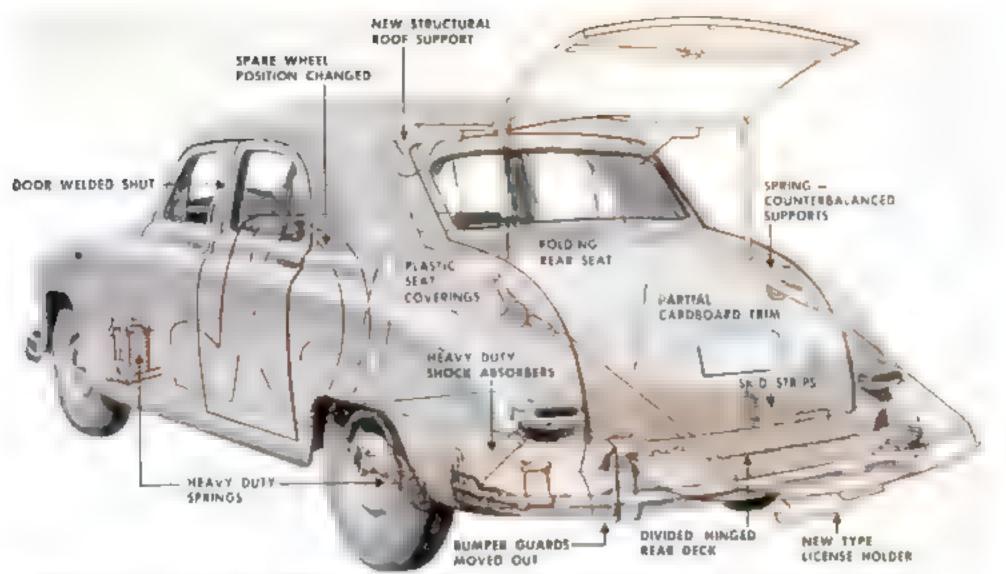


gate is up (lower picture), spring locks plate in normal position. Sturdy piano-type, 20-in. huige (left) secures tail gate to body, replacing ordinary strap hinges of conventional Kaiser sedan.

Shrouded space is bolted to dummy left rear dear Rear scat is narrowed to make room for the tail-gate chains and appealed hinges are covered with vinyl to prevent rattles.







Multitude of changes in nibits sedan as compared to standard sedan are partially shown in thus drawing. Most promusent in body-support structure are reinforcement strips of 16-gauge

hot-rolled steel around top and sides of opening. Car has no rear package shelf. Left rear window and right rent yent window do not open. The front floor covering is rubber-covered fute.

When the walking conference was over, Hammond returned to Willow Run to start experimenting. One provision was mandatory: with the rear of the car closed up, the design must leave intact all the visible and structural features of a standard sedan.

They sheared out the skin at the rear of a sedan body, leaving the rear window untouched. By mid-August they were experimenting with the side linging of a deck lid. That didn't work. It was awkward. They discussed splitting the door in the center and hinging it at both sides, like the doors of a panel truck, Finally, on September 14, the roof above the rear window was cut into. Then they split the lid horizontally

Plywood bridge, stripped with metal, is dropped between car bed and tail gate for easier loading. When not in use, the bridge locks under spring chp on left wheel-well covering,

and put the hinges at the top and bottom

This was it. The production model of the utility car will be substantially as Hammond and Edgar Kaiser devised the hinging and as Henry Auschuetz, head of the development-engineering department, conceived the improved folding-seat plan,

Only 60 days had elapsed from idea to rough prototype.

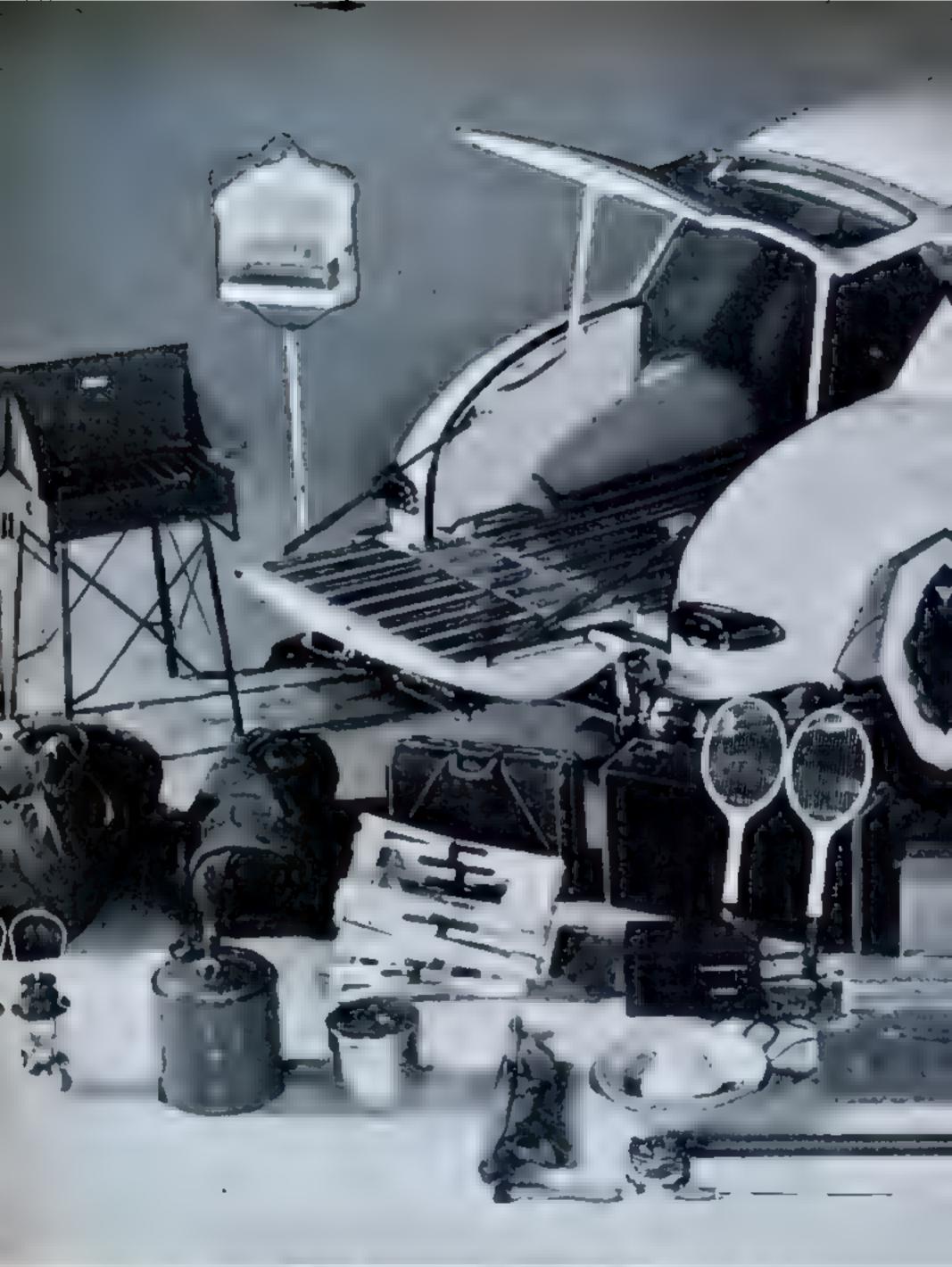
The idea was simple, all right, but a whale of a lot remained to be done in the design department before the vehicle could be put into production. Big and little, more than 200 changes had to be incorporated into it before the car actually came into being. Springs and shock absorbers had to

Space behind rear-wheel wells can be used to carry tools and other small items. These stowage spaces are covered with panels secured | with quick-release, aircraft-type fasteners.



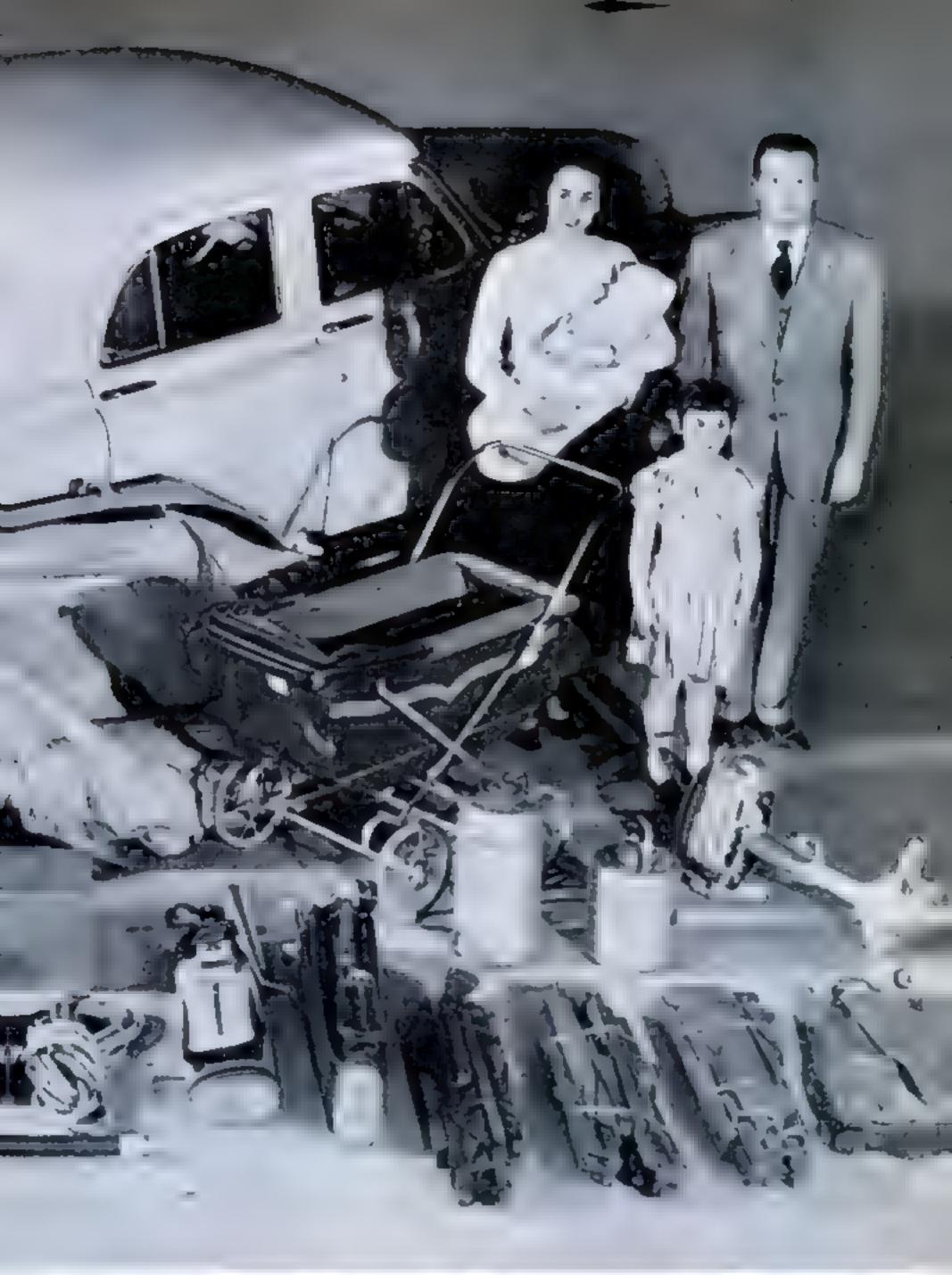






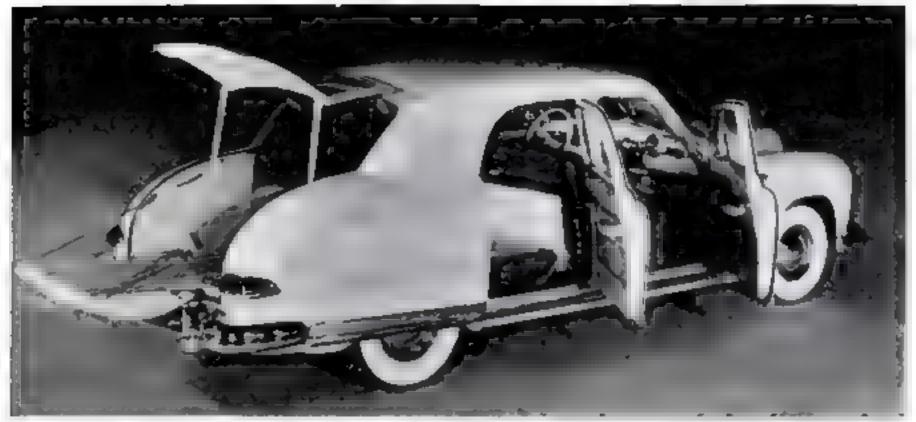
Everything for a camping trip except the cabin can be packed into the back of the new

Kuser utility sed in Model shown here is the Varibond! Family of four will ride in regular-



rit orthogram ter collessor are a file

ny stove portable nee bey care cons I san be constructed by formal of miserial trans-



Plushy version of utility car, the Vagabond®, has 112-hp, engine compared to 100 hp. of cheaper Traveler®. It also sports more chrome trim. Rub strips are wood instead of metal.

Overdrive is standard on Vagaband Rear window of both models is 6% in, narrower than that m standard sedan, whose window line comeides with utility car's rear-end opening,

be beefed up to take bigger loads. Some of the wiring that lay on top of the floor pan in the regular sedan had to be ducted undemeath for the utility car so it wouldn't get in the way of a power lawn mower or a roll of barbed wire or milk cans. New piercings had to be made for the rear-window opening and new dies for the whole rear of the body. In shearing the body, all the strength of the wrap-around skin was lost, and a reinforcing member had to be engineered for insertion above the cut.

Fittings Had To Be Strengthened

The lower deck lid was too heavy for opening with a single handle, and a T handle had to be made for it. Its strap hinges had to be replaced with a plano-type hinge if it was to serve as a sturdy loading platform. Hinging and lighting the license plate so it could be pulled down 90 degrees when the tail gate was open and still conform with the laws of 48 states, took one engineer's time for weeks. Some economies had to be made if the car was going to undersell the conventional sedan. meant removing some of the fluff,

Outwardly, and in the driver's seat, the car is the same. Engine and frame remain the same. Wheelbase, clutch, transmission and gear ratios are unchanged. When you sit behind the wheel, the instrument panel looks, and is, exactly like that of the standard Kaiser sedan. The only tip-off is the plastic scat covering, easily washable,

But anyone who tries to open that left rear door will think it is locked. Actually, it's welded shut; the spare wheel and tire

had to go somewhere.

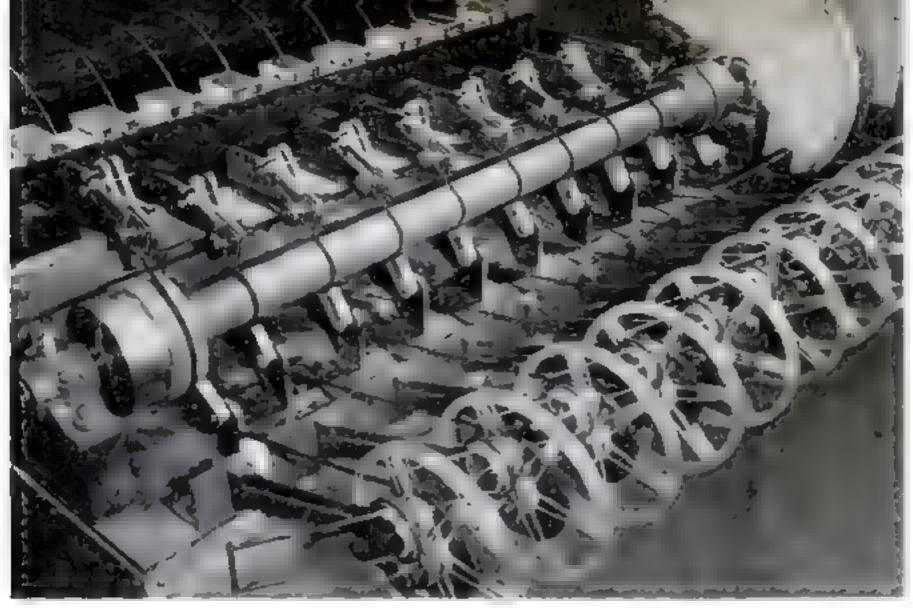
The "utility car," is a product of the company's unconventional thinking. The elder Kaiser is a maverick in industry. It was be who produced ocean freighters for war on an assembly-line basis by means of prefabrication. His chief engineer thumbed his nose at tradition fifteen years ago to design an airplane that almost anyone could learn to fly with an hour's instruction. All the K-F officials are from the same stamping mill.

And yet: "You know, our hardest job on the utility car," commented H. V. Lindbergh, manager of styling, "was in overcoming the feeling that it couldn't be done " And yet: a new segment of the market has been tapped; two new models have been added to the dealer's line without the crushing expense of a major model change,

Needless to say, Henry J. Kaiser will have one of his new utility cars at Lake Tahoe as soon as he can get one off the assembly line.

Bulb Burns Three Years

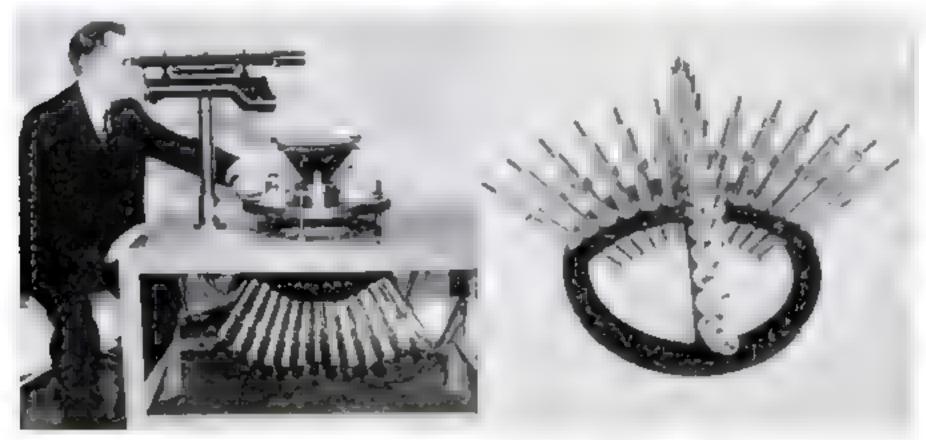
A LAMP only 1/25 as big as a penpoint, made by Westinghouse, will burn continuously for three years. Its red-orange glow will indicate whether your electrical appliances are operating and guide you to fuses and outlets.



Tape Records Mass-Produced

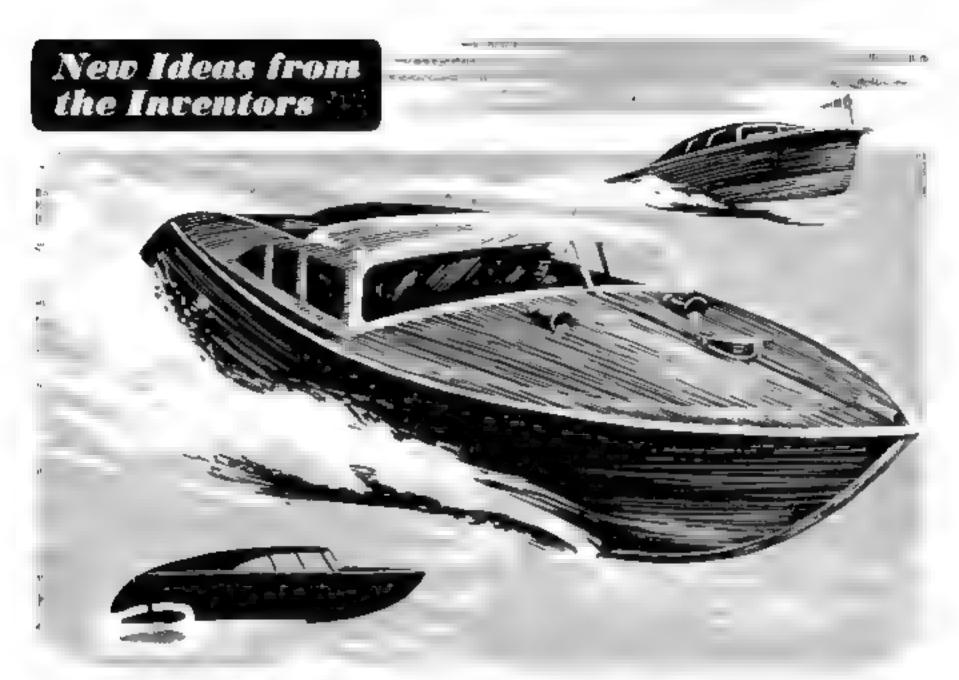
This multiple tape recorder removes the last obstacle to commercial recordings on magnetic tape—the mass production of duplicate tapes. It makes eight duplicates at once at three times normal speed. It can also record two sound tracks on the same tape at the same time. Thus the machine

can turn out eight hour-long recordings in 10 minutes, or 48 an hour. Signals from a master tape are amplified and then fed into recording heads, shown above. A common capstan keeps the master and copy tapes at the same speed. In playback, one side of the double sound track plays as the tape reel unwinds, the other as it winds up. Minnesota Mining and Mig. Co. made it.



Parallel Light Tests Lenses

THE spiked, crownlike object at right is the heart of a new Bureau of Standards device to test the lenses of aerial cameras. It consists of 25 collimators arranged in a cross to cover the entire field of a lens. Light rays passing through the 25 tubes are rendered parallel to simulate actual sunlight. To test a camera, placed on the table at left, 25 tiny beams of light are shone up through its lens and into a collimating telescope above. This light pattern, magmiled by the telescope, provides an accurate check on the focal length, distortion, and resolving power of the lens.

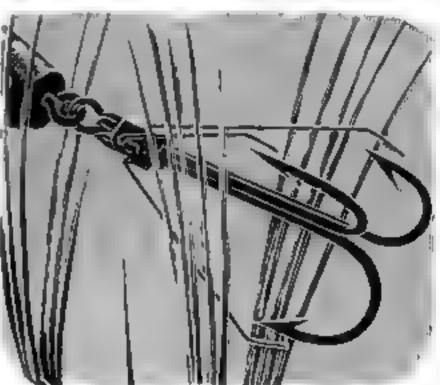


Heat Pontoons Cut Brag. A pair of pontoon floats keeps this speedboat skimming flat over the water instead of dragging at the stern with its bow in the air. They swivel under the stern, and are

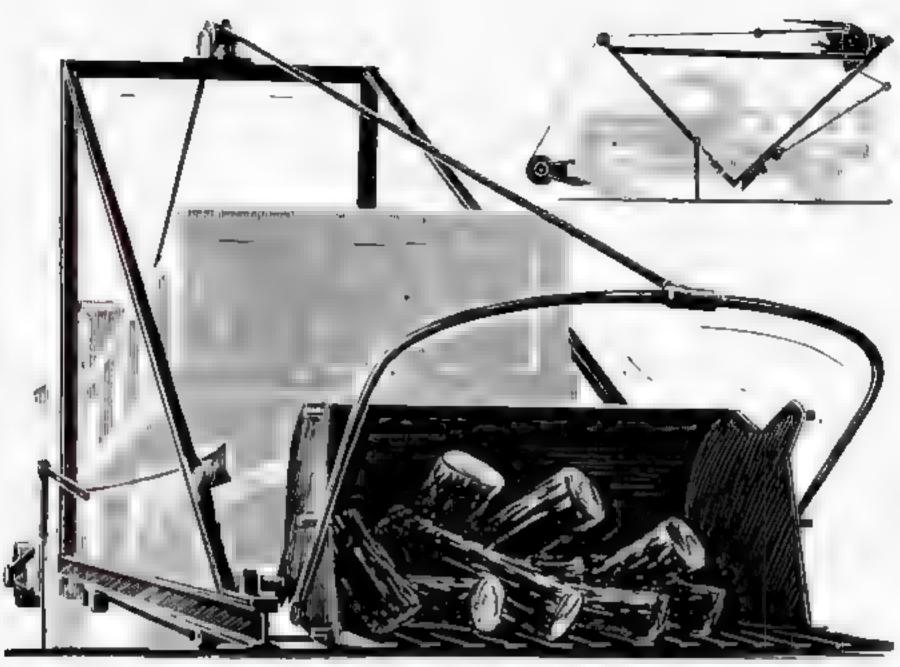
lowered hydraulically as the speed increases, raising the stern and permitting greater speed. Invented by E. W. Berger, of San Diego, the floats can be manually operated or automatically controlled by the speed.



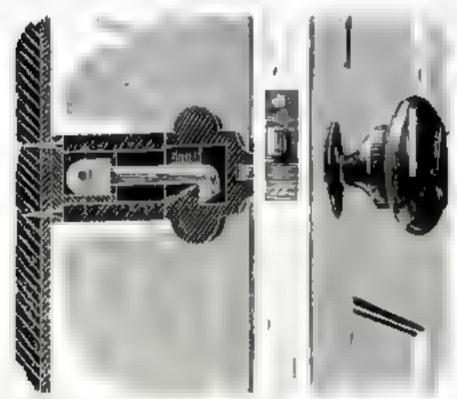
Food Dish Aids Appetite. Junior might get more fun out of eating—and eat more—if he used this dish with a toy dog on the rim. One bite for Junior, one bite for Fido—only Junior ends up eating it all, because Fido's food runs back into the dish through a tube in the front paws. It was invented by B. B. Manaster, of Chicago.



Hook Guard Stops Weed Snags. Fish, but not weeds, will cause you to feel a tug on your line if you use this hook. Fine, spring-steel wires shielding the hook's points allow it to slip through weeds or over obstructions without snagging. When a fish strikes, the wires are pushed inward. The inventor is H. M. Heimark, of Oak Park, Ill.



Truck Loads Itself. The driver of this truck can pick up a load without ever leaving his seat. The large triangular frame, pivoted at the center of the truck, holds a scoop bucket at its rear end. When a powered winch on the front of the truck pulls the bucket, the whole frame tips forward, like a seesaw, raising the bucket over the truck and dumping its contents. The loader was invented by S. Smith, of Bend, Ore.



Wall Latch Holds Door. This novel doorstop, patented by A. J. Harris, of Long Beach, Calif, automatically holds a door open when it's pushed against the wall. A hook in the wall slides into an open ing in the doorknob and locks over a ridge Giving the knob a half turn slides the ridge from under the hook, releasing the door



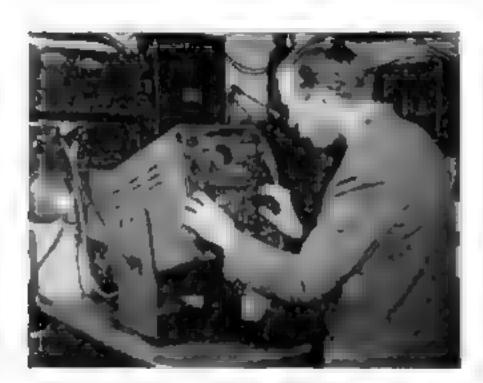
Chin Jabber Wakes Drivers. You shouldn't fall asleep at the wheel with this chin jabber on the job. Worn around the neck, it holds a sharp prong under the driver's chin. If his head nods, the point quickly awakens him. Invented by K. H. Liman, of Rye, N. Y., it has a rubber knob below the tip to prevent serious injury.



Putting a Generator Together

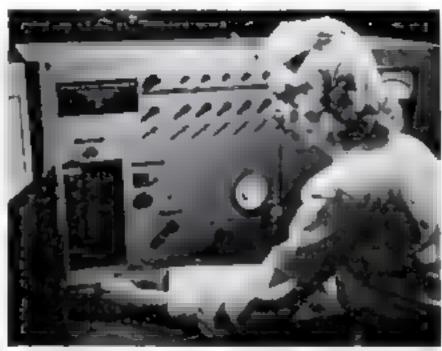
THE four enormous metal segments in the foreground above are part of a huge water-wheel generator being constructed at Westinghouse's East Pittsburgh plant. Each section weighs 43,000 pounds. When all four

are put together, they will form a horizontal ring 30 feet in diameter and 6 feet high. This will be the stator, or stationary part, of a 430-ton generator. This monster will produce 28,000 kw. of electric power, enough to supply about 56,000 homes. In the background are two steam-turbine generators.



New Loran Aids Fishermen

Finding your way to profitable fishing grounds in any weather is no trick with this table-model loran. Small size is only one advantage of the new electronic navigator, according to Sperry Gyroscope Co., its designer. It is also easier and faster to operate than earlier models. Skippers within range of shore-based transmitters can accurately fix their position at sea in less than five minutes, without having to check sun or stars. The Army Transport Service and the U.S. Coast Guard have ordered the equipment.



Meter Tests TV Tubes

You will probably never use the recording spectroradiometer shown above, but its application in the laboratory may result in clearer images on your home television screen. It is a new scientific instrument that accurately plots the full range of visible light produced on a television viewing-tube screen. Sylvania Electric Products, Inc., which developed the device, says that it is fully automatic and will do the job of analysis in 48 seconds: old hand-plotting methods required half a day.



Rescue Boat Built Like Plane

Tins new British air-sea rescue craft, the Celerity, has nearly everything she would need to fly except wings. Four 1,675-hp. radial, air-cooled aircraft engines drive four variable-pitch propellers. And her superstructure and most of the fittings are of a light, aircraft-type alloy.

Because the air-cooled engines require no bulky water-circulating systems, there's

more room for rescue gear and fuel in the 105-foot craft. It has a top speed of 40 knots and a range of 4,200 sea miles. The variable-pitch propellers need neither clutches nor reverse gears and, being individually controlled, increase maneuverability. When crossing on only one or two engines, the idle propellers can be feathered, like those of a plane, to cut drag.

The 80-ton craft, armed and partly armored, was built by the Bristol Aeroplane Co.



New Fins Lighten Radio Tube

THE weight of this 25,000-watt radio-broadcasting tube was cut from 225 lb, to 98 lb, by using aluminum instead of copper for its cooling fins. This was made possible by aluminum-to-steel bonding, developed to lighten airplane engines. The fins are brazed to a steel hub that, unlike aluminum, can be soldered to the copper anode.



New "Iron Lung" Is Portable

THE Blanchard Portable Respirator[®], in use above, permits a patient who needs mechanical help in breathing to be treated in any hospital bed. Its Plexiglas[®] vest, shaped like a coat of medieval armor, seals at neck, shoulders, and waist with rubber ties that leave legs and arms free. The motor-pump unit (on floor) plugs into any outlet.

Tires Without Tubes Come Back into Style

A radical new design, immune to punctures and blowouts,

modernizes the "pneumatics" of motoring's pioneer days.

By Myron Stearns

A NEW tubeless automobile tire, puncturesealing and highly resistant to blowouts, has been developed by the B. F. Goodrich Company. Its makers expect that it will eventually change all tire manufacture, which today amounts to about 80-million truck and passenger-car tires a year.

And so, after 53 years, tires without tubes are back in style. The first American cars placed on the market, Cleveland-built Wintons, used overgrown bieyele tires that held air in the same casings that rolled upon the

New tubeless tire runs over plank studded with nails, completely piercing all its layers, in convincing demonstration of its ability to sustain repeated punctures without loss of air

road. But the 1896 rubber was unequal to the task, and tires with easily repaired and replaceable tubes soon superseded the crude tubeless easings, which were good for only 500 miles. Now the cycle is complete, and inner tubes may become as outmoded as a Model T.

Recently the owner of a car equipped with the new tires left it at a service station to be greased. While it was up on a hydraulic hoist, a mechanic called his attention to a nail in one of the casings.

"Want it changed?" he asked.

"Let's have your phers a moment," the motorist countered. He pulled out a long nail. The mechanic waited for the air to hiss out. It didn't.

300 Punctures-No Leak

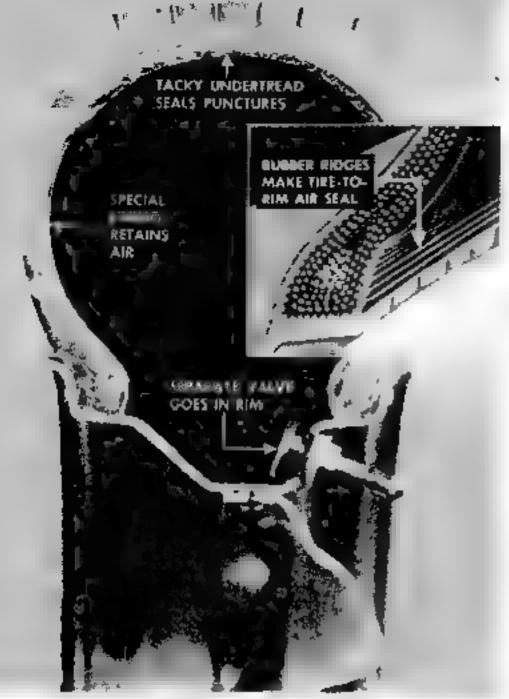
For the benefit of a newsreel photographer, one of the new tires was run 50 times over a board that had six big nails sticking out of it. That meant some 300 "punctures," and it lost no air.

In a car equipped with tubeless tires an Indiana state trooper was on a chase, throttle to the floor, when a loud clack-clack-clack against the concrete pavement began. Instead of slowing up or stopping, he kept on and got his man. Then he investigated. A three-inch-long bolt had driven into a front tire. He simply pulled it out and drove back to headquarters.

Tubeless casings have been tried out on taxicabs in Dallas, Tulsa, Cincinnati, and Philadelphia. Florida state police, as well as Indiana troopers, have been using them.

They can be wrecked, but it's difficult to do. Half a broken beer bottle, cutting a two-meh hole, might conceivably ruin them. One went flat when a short piece of half-meh tubing went through it, making a half-inch metal vent.

After the fabric in an ordinary tire becomes damaged, the tube inside holds air until the chafing against the broken tire



Sawed-through section of tubeless tire on run illustrates its special features. In inset diagram, part of run is omitted to show ridges, on outside of tire, that form air scal against it.

cords is too great. Then it "blows out" just as a child's rubber balloon explodes. But in a damaged tubeless easing, the air begins to leak out slowly. There's no sudden letdown

Efforts to make tires blowout-proof have been going on for years. Initially they concentrated on the tube. Since the '30s the Goodyear Tire and Rubber Company has had a premium-priced, double-lining inner tube called Lifeguard® on sale. At the New York World's Fair ten years ago the Goodrich company exhibited tubes with a "sealing" layer of soft, partially vulcanized rubber that immediately closes any small opening. Bullet-proof gasoline tanks that carried our warplanes through enemy gunfire used the same principle. But the greater cost of the safety tubes, about four times that of ordinary tubes, held them back. With tubeless easings, a good share of the greaterprice barrier has been overcome.

The new tires, in the most widely used size of 6.00 x 16 inches, are sold for \$24.95. That falls between the ordinary first class casing-and-tube cost of about \$19 and the ordinary-casing-plus-safety-tube cost of about \$28.

In the long decline of tire-nuleage costs, that is not bad. In 1920, when tires would stand up for 12,000 miles, the tire cost per 1,000 miles was about \$2.25. In 1947, with an average life of 25,000 miles, the tire cost per 1,000 miles for the most popular sizes was only about 60 cents. The tubeless-tire cost for the average family motorist should be about 70 cents per 1,000 miles. Some have already been driven more than 40,000 miles.

By gripping firmly against the steel rim of the wheel itself, the new casing holds air without the necessity for any air-containing inner tube. It seems to make the car ride a little more smoothly than other tires. You can't loosen it from the rim by banging it against a curbstone or rock. An ordinary valve, such as regular inner tubes have today, is held in place in the customary hole in the rim by nuts screwed tight against two rubber washers. This separate valve with its special seal is provided with each tubeless tire sold. The new tires are inflated to the same air pressure as standard ones—28 pounds for the 6.00 x 16 size.

Idea Born from War Needs

The inventiveness and ingenuity of a young technical engineer, Frank Herzegh of Cleveland, are responsible for the new tire development. He personally persuaded the Goodrich higher-ups that a single tubeless easing would eventually prove superior to the more complicated easing-and-tube combination. His efforts have guided it through years of experimental work and at last into successful production.

His first idea for it grew directly from meeting combat-tire requirements during the war.

Even before Pearl Harbor, our Government had asked tire manufacturers to develop a battle tire that could be run flat for at least 75 miles, after being riddled with bullets or shell fragments. Both Germany and France had made one filled with sponge rubber. It was excellent for battle use, but on long hauls it got too hot and became worthless after a few hundred miles. Improving on it, the British reinforced the side walls of a tough, air-filled tire with extra rubber that would last for 50 miles of running flat.

In November 1941 our first experiments with similar combat tires began in Florida, on the Tamiami Trail. They were not good. The best tire ran only 22 miles. Buckets of water had to be kept handy for putting out fires when the tormented rubber blazed up.

But eventually, with better and better rubber compounds for side-wall reinforcement, we got tires that could run flat for 150 miles. Part of General Patton's smashing success in his rapid advance through France and into Germany was due to American combat casings. His troops and equipment could be moved even faster than the Germans'.

The tough rubber lining that made combat tires last even when they were run flat gave Herzegh his idea—not for running on flat

tires, but for eliminating the tube,

"Since the lining extends all around the inside of the cusing," he reasoned, "and keeps air out of the fabric, why not have the tire fit tightly enough against the rim to hold in air and use no tube at all?"

Herzegh first got his air-seal idea in January 1942. He soon developed casings that would hold air satisfactorily. The tires on his car have had no inner tubes since 1942.

First tests were run in March of that year, Industry-wide tests followed, since all valuable rubber ideas were pooled during the war. The tubeless tires were tried out on military maneuvers. Then the idea was tossed on the scrap heap—because it required difficult precision work,

The Man Who Wouldn't Quit

Herzegh might easily have quit in discouragement. After more than a year and a half of work, much of it seemingly successful, leading tire experts said he was wasting his time. But he persuaded his superiors to keep on experimenting to develop tubeless civilian tires.

Literally hundreds of different rubber compounds were worked with to get a thin lining in place of the thick hinings that made combat tires last when they were run flat. It had to stick properly to the inside of the casing under all conditions of flexing and heat. After almost endless experiments, butyl rubber, developed by the Standard Oil Company (New Jersey), proved to be the answer. A tenth-of-an-inch thickness of it will hold air as well as a solid inch of ordinary rubber.

At first, to make the rim airtight, Herzegh inserted a big circle of thin soft rubber, as large as the wheel itself, between the rim and the casing. It worked; but unless it was placed just right, the air leaked out. These experiences led to a one-piece, self-sealing tire with rubber ridges along the outside of the bead where it rested against the rim.

The first tubeless tires for civilian use



Frank Hersegh, young engineer who developed the new tubeless tire, shows above how its valve is attached separately on rim. The rim itself forms part of the air-retaining chamber

were tried out for about a year before the extra layer of gum rubber was added to make them puncture-scaling. Even after that a lot of testing had to be done.

Until February of this year the tubeless tires were sold in only two areas, around Indianapolis and Cincinnati, while production was tried out on a small scale. Production has been built up slowly, because both factory handling of the new carcass-construction techniques and servicing of the new product by tire handlers must be thoroughly learned. Filling-station attendants have had to know, for example, how good a rim must be to hold air satisfactorily with the new shoes; if it is bent, or too badly pitted with rust, the air will leak out.

This February the new casings were put on sale in Florida, so that car owners in three states are now able to buy them. During 1949 all five Goodrich plants will be turning out the new tires in quantity for national distribution, "As the demand mounts," the Goodrich officials say, "we will be able to step up production to meet it." And they add that at least three of their competitors are already working feverishly on tubeless-tire problems.

Sound Carries 90 Miles

UNDER freakish atmospheric conditions, the sound of gunfire from a U.S. battleship during target practice has been heard distinctly at a distance of more than 90 miles.

Popular Science shows you the innards of Brookhaven's nuclear furnace.

U.S. Lights New



Model shows ususual features of sudding that houses characomprise in which and given petron at imposing research languatory on Long Island

Atomic Pile for Peace

By Martin Mann

SOMETIME this summer a young man in a sports jacket will twist a few knobs with his eyes fixed on a Geiger counter, then turn and say, "It's critical." The atomic pile at Brookhaven National Laboratory then will be running under its own "steam."

This, the fourteenth furnace ever built to release and control the terrifying forces in the heart of the atom, will be the world's most powerful air-cooled pile. Only the water-cooled giants that manufacture plutonium for bombs at Hanford, Wash., outrange it in the U. S. Brookhaven's pile, however, will not make fuel for bombs, and may not produce any usable power. Instead, it will produce more wrinkles in men's brows—by increasing their knowledge.

Drive out Long Island's Jericho Tumpike 65 miles from New York City to the edge of the duck- and potato-farm country, then Brookhaven National Laboratory," and you will quickly spot a big, striped smoke-stack. It towers above a group of modest frame and concrete-block buildings that house the laboratory. The smokestack and the most imposing buildings are on the side of Rutherford Hill—named for Sir Ernest Rutherford, the British physicist who laid the foundations of nuclear theory.

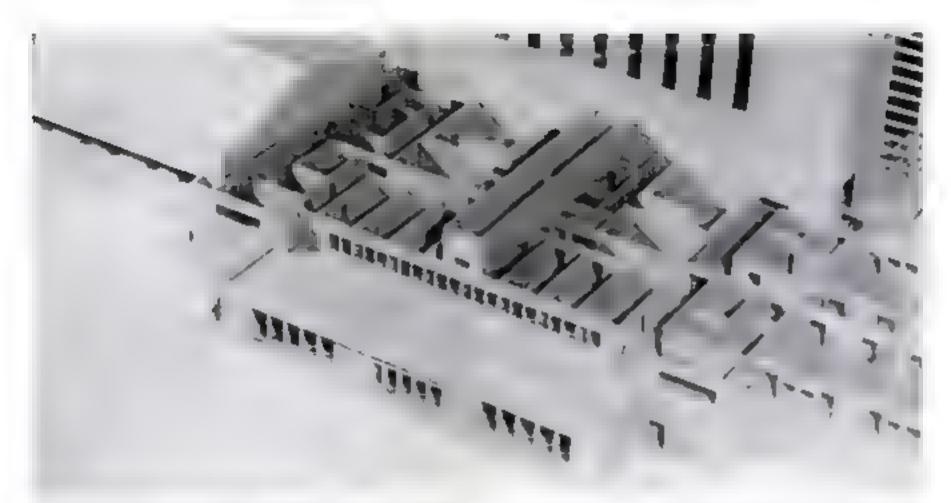
The biggest building, a light brick structure six stories tall, with two gigantic, greenglassed bay windows, contains the pile. It has two lower wings for laboratories especially designed and equipped for workers with radioactive chemicals. And there is a detached building in the rear for the "hottest" laboratory, where experiments with intensely radioactive substances can be conducted by remote control. Nearby are the fan house, cooling towers, and stack.

No smoke will ever belch from the stack



CONCERN SHIPS MICLOSHIP PLA ENDS OF HOLES HOLDING URANIUM LOUGGPEARIN LARGE WINDOW Unique features of Breakhaven National Laboratory's new exemic pile are brought out in this sketch. The presentic tubes on one side will be used to shoot materials into the pile, then deliver them to laboratories while they are het. The tennels below will be used to subject experimental enimals to radiation. Windows on other sides will let invisible beams sheet out for other apperiments. 22 POPULAR SCIENCE

CAND DANGE OF THE PROPERTY OF THE PARTY OF T li li of removable blocks WINDOWS LET RAMATION OUT OF PILE iliti i de Caracteria de la Caracteria d DOME PROMINENC TO BO PROCEET TO HEARET LABORATOR Andrew Cas little triallytring THROUGH THAT SENDS ANNAUGH STORES PAGE POR COGLAMO AND APRIL 1949 123



Scale model of the pile building has removable sections to show details of layout. Corridor that provides path for 60-ft, neutron beam can be

seen in center. Layout of halls gives two routes to each laboratory (in right and left wongs) in case one path is blocked by an accident.



Back view of the model shows section where the manuom metal will be landled. Shop for machining it and vault for storing it are on lower

floor, other sloops and offices above. Large door to pile room provides access to entire "lattice". -- the openings that hold the uranium rods.

of this plant (PS, Nov. '48, p. 108). Instead it will release the cooling air that gigantic fans will whirl through the pile at a rate of many tons a minute. And this radioactive air will come out of the stack only when atmospheric conditions are such that it will be safely dispersed

To go maide and see the pile itself, you need a "Q" clearance from the Atomic Energy Commission. The drawing on pages 122 and 123, however, shows you even more than would meet your eye if you

walked into the huge room containing the beige-painted concrete cube, about 40 feet on a side. Only three faces and the top are exposed. The back—not visible in the drawing -is where the uranium is put in. Because this pile "burns" so fast, a new charge will be needed at least every few years.

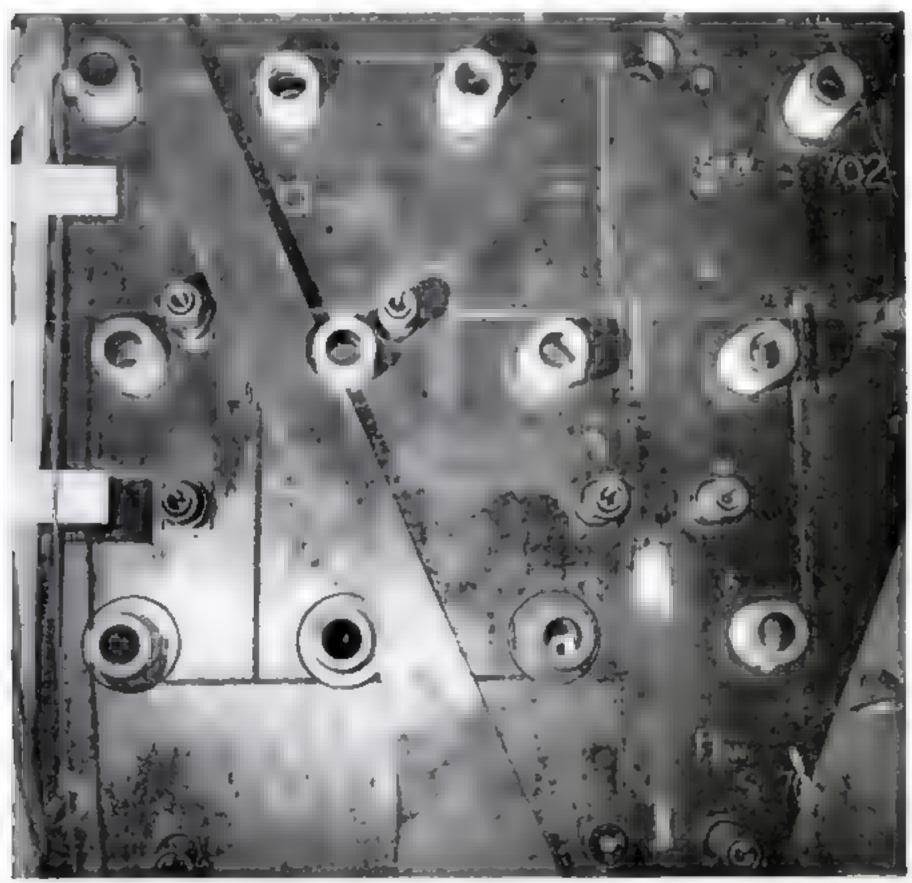
The three visible sides bristle with balcomes, tubes, rods, switchboxes, and wiring. On the two parallel working faces are seven rows of small windows. Most of these are about four inches square. These windows go directly into the hot heart of the pile. Material can be inserted through them for irradiation inside the pile. And beams of neutrons, gamma rays, and all the other kinds of particles and waves can be let out of the pile through them. The windows extend all the way through to both faces, in case something placed inside has to be pushed out. Balconies sticking out from the faces of the pile give easy access to the upper rows of windows.

The north face of the pile (directly in front of you in the drawing) has a system of pneumatic tubes that reach into its center. These tubes are like those used in department stores to relay orders and make change. Here they will be used to shoot material into the pile to be bombarded with

neutrons, and to whisk back the newly made isotopes. This arrangement permits study of short-lived isotopes, the ones that lose their radioactivity and change into something else in a few minutes or even seconds.

Some of the pneumatic tubes end at the pile face itself; others extend under the floor into nearby laboratories, so that the isotopes can be delivered straight to a scientist's workbench. It is even possible to connect the tubes directly to experimental equipment, so that a fresh radioisotope will pop right into a test tube or flask and immediately become part of an experiment.

On the same face of the pile you can also see the lattice-the ends of the openings that hold the uranium rods. These



Atom's-eye view of the pile from maide of it. This photo, made during construction, shows

inside of one face with openings that let materials in, radiation out. Note workman at right.



openings extend through the pile. The actual loading and unloading, however, always will be done from the opposite side.

One other opening in the south face is a large one, about a foot square, set in the



Most of the pile is graphite, like lead in pencil. You can actually write with it. Above is model of one of more than 60,000 graphite bricks used.

very center. It allows a beam of neutrons to shoot out of the pile and down a corridor built for it through the adjacent laboratories and offices. Such a beam, 60 feet long, may help experimenters determine the extent to which distance affects the ability of various materials to absorb neutrons.

When the pile is cut off, scientists may also work on top of it. The top is made up of 4-ft. square concrete blocks that can be lifted out to make openings wherever the researchers want them. These large openings do not give access to the center of the pile, but merely expose its outer graphite shell. A lot of slow-moving neutrons leak through the shell (this "leakage flux" is about 1/50 as intense as the neutron beams from the heart of the pile) and can be used for experiments in big apparatus placed over the opening in the shield.

Tunnels for Tests with Animals

As a visitor to the pile room, you might also notice trapdoors in the floor. They lead to two tunnels that pass directly underneath the pile. In each tunnel there is a small car, pulled by motor-driven chains, that can be moved back and forth through the tunnel and stopped under an opening in the pile's bottom shield. The smaller car is for exposing instruments to the full blast of radiation from the pile. The larger one can carry animals as big as chimpanzees.

Animal experiments may reveal a cure for radiation sickness—whether caused by an accident or a bomb—and may also tell much about cancer, heredity, and the other biological mysteries. This is the first installation permitting studies with animals of near-human size and complexity. Previous work at Oak Ridge has been limited mainly to rate and rabbits.

Inside the concrete cube there are 60,000 pieces of graphite, which resembles the lead in your pencil but is nearly 100 percent pure. There are 2,600 different sizes and shapes of these pieces. Putting them together was like assembling a colossal Chinese puzzle. These thousands of "bricks" were made so accurately that they fit together to form an almost airtight mass without needing cement or mortar between their joints.

Inside this graphite block, within the concrete cube, is a maze of channels. Aluminum cans containing the long rods of uranium that make the pile powerful fit into some of them. Others are for the cadmium rods, which the operators can slide in and out like pistons to regulate the rapidity with which the invisible neutrons split the invisible atoms of uranium. Still others are the ducts through which the air to cool the pile circulates.

Fuel Is a Mixture of Isotopes

The uranum in the Brookhaven pile is "natural" material. It is highly purified, but is still a mixture of the three isotopes—U-234, U-235, and U-238. Only the U-235 atoms fission (split), and they are barely 0.7 percent of the total.

Nevertheless, the Brookhaven pile will run at fairly high power—unofficially estimated at about 5,000 kilowatts or more, Most of this power will be wasted, but about 1,500 kilowatts could be converted into electricity to help run the cooling fans. (Outside power would still be needed for the fans, however, since they draw much more than 1,500 kilowatts.) If this is done, the Brookhaven pile will become the first in America to generate useful electric power.

But the new pile will not produce anything like 5,000 kilowatts immediately. At first its power output will be nearer zero. For it will be "warmed up" slowly and will not be operated at full power until, possibly, sometime in July. This slow rise in output will give the engineers a rare opportunity to learn things that cannot be learned after a pile has its full load of fuel. During this build-up period, scientists will study the pile closely, watching the neutron production in various sections, the changes in the

graphite bricks, the effects of weather conditions, the way the control changes with increasing power, and how fission products build up in various parts of the pile.

By next fall the research program for which the pile is being built should be running full blast. It will cover nearly every field of science—physics, chemistry, biology, medicine, and all the rest. But much of it will be concentrated on chemical and metallurgical problems related to materials used in piles. For materials are the main stumbling block to atomic progress now. If the engineers had the right materials, they could design good nuclear engines for power plants, rockets, airplanes, or warships in a jiffy

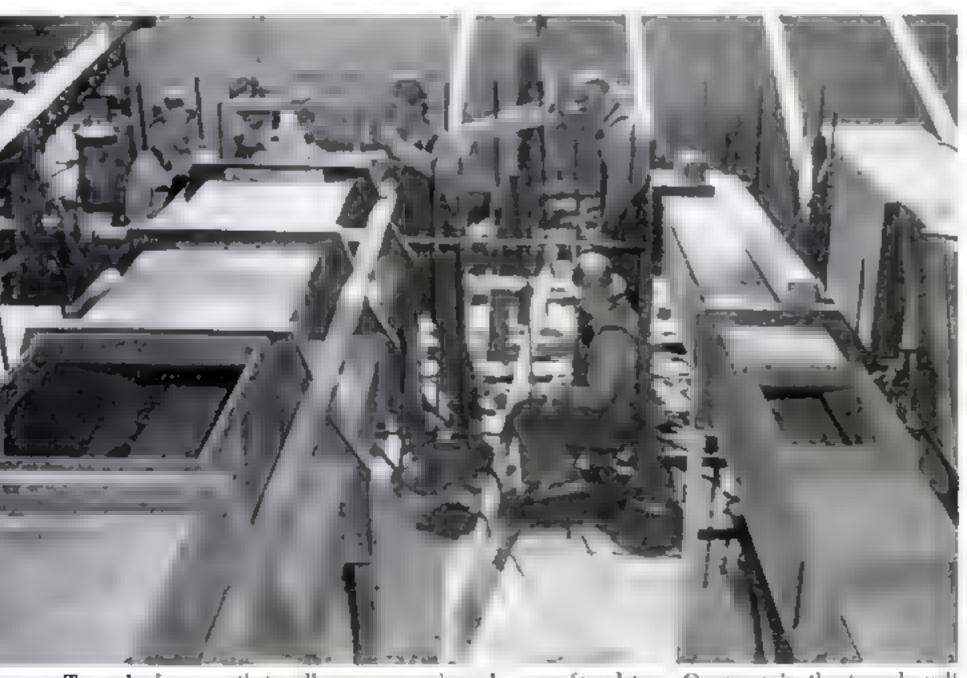
Will Gold Shield Atomic Engines?

Shielding is one of the toughest problems. The shield on the Brookhaven pile—the part you can see—is made of a special, secret kind of concrete at least six feet thick. You can't put that heavy a shield in an atomic rocket, or even a battleship. But what can you use that's lighter? Professor Walter G. Whitman, head of the chemical engineering

department at M I.T., recently made a study of light shielding materials for the Atomic Energy Commission. His report: the cheapest shield now available would be 24-karat gold!

Another big problem is finding structural materials to use inside an atomic engine. Most ordinary things either react badly with neutrons or melt under the high temperatures. Steel absorbs neutrons so fast that it would stop a pile completely. For a while, the unusual metal transum (now used in white paint) looked like a good bet, but it has not lived up to expectations. Zirconium might work, but it is always accompanied by hafnium, which is bad. Rubidium and caesium, two other possibilities, are too scarce.

Then there is the ash headache. When a U-235 atom fissions, it breaks into two pieces—two new elements each weighing somewhere around half as much as uranium. (These fission products are not always the same elements, but may be any of the 24 that range from selenium to lanthanum in the periodic table.) The fission products will not fission themselves. Worse than



Tonnels for ears that will carry animals and instruments under the pile were set in the mass-

sive foundation. Openuizs in the tunnels will expose the cars and their contents to radiation

that, they absorb neutrons, reducing the power of the pile. Nucleonics experts call

this process "poisoning the pile."

The poisons, or nuclear ashes, have to be taken out after the pile has operated a while. But mixed in with the ashes is a lot of good, fissionable uranium far too valuable to throw away. As Sumner Pike, one of the members of the AEC, once said, a pile is like an inefficient coal furnace that lets un-



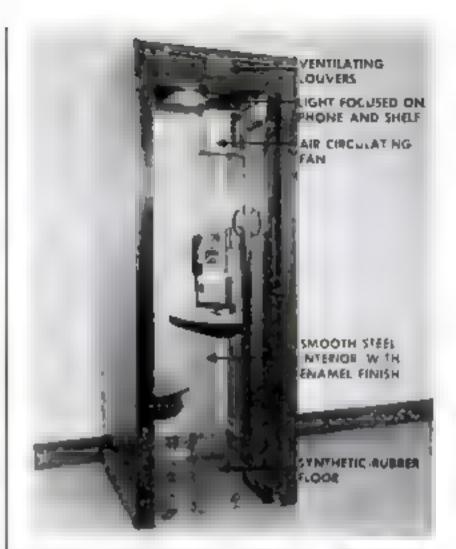
These men will lead the search for knowledge made possible by the pile. Dr. Lyle B. Borst (left) heads the pile project, and Dr. Leland J. Haworth (right) is director of Brookhaven.

burned coul fall into the ash pit. You can shake the ashes, get that coal out, and put it back in the furnace. But the nuclear "ashes" must be shaken at least 10 times to get all the uranium out. These ashes also contain plutonium, the fissionable stuff in bombs, and other materials so radioactive that you dare not get too close to them even if you wear an ashestos suit.

So ways must be found to reduce the poisoning effect of the fission products, so that the ashes won't have to be shaken so many times. More efficient and cheaper methods of doing the shaking must be learned, too. Present estimates indicate that a plant for shaking an atomic ash barrel would cost as much as the atomic power plant it would accompany. And somebody has to figure out an easy way to get rid of the left-over radioactive "garbage," now mostly buried in huge underground tanks.

The Brookhaven experimenters may not answer these questions—or even attack them directly. Brookhaven's scientists merely seek facts, any kind of facts, not just those dealing with power plants and rocket motors. Yet the basic facts of nature are the bricks out of which some men, somewhere, sometime, still build power plants and rocket motors.

END



Meet the New Phone Booth

HERE's the phone booth you will be seeing soon in your corner drugstore. Designed by Bell Telephone Laboratories, it has a ventilating system that changes the air several times a minute. An improved lamp concentrates four times as much light on the instrument and writing shelf. The interior is finished in a beige "hammer effect" that masks scratches.



Leak Sniffer Tests Footballs

This picture shows a sensitive laboratory instrument hard at work in a new job: checking footballs for leaks. GE developed the electronic gas detector (PS, June '48, p. 113) to test airtight apparatus. Now the Collette Mfg. Co. uses it on footballs by inflating them with Freon. If any leaks, the detector suffs it in air sucked into the probe.



Extra Sense Added To Navy Autopilot

By Herbert Johansen

Drawings by Ray Pioch

THE colorfully garbed landing-signal officers aboard our aircraft carriers may soon be out of a job.

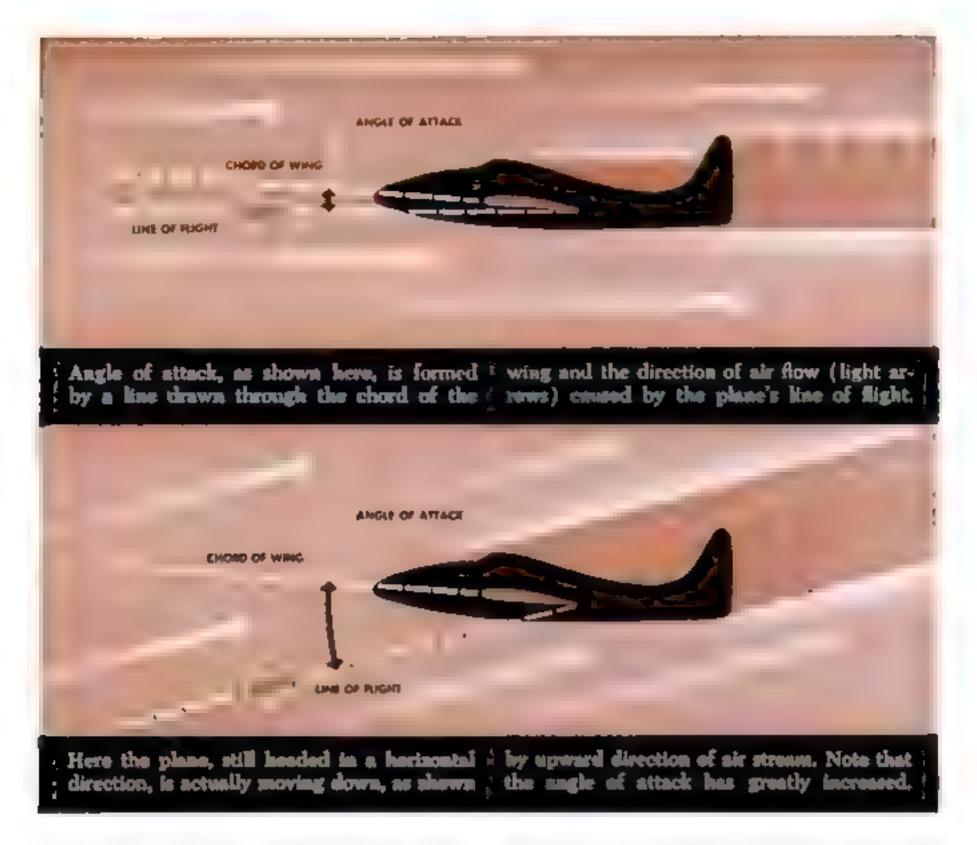
When that happens, a pilot coming in for a landing need only drop his wheels, flaps, and hook-then sit back with his hands folded. The landing-signal officer's job will have been taken over by a man deep inside the ship. Sitting in front of radar and television screens, he will beam orders to a robot pilot in the approaching plane. The pressing of buttons and the flipping of switches will bring the plane down on the deck for a perfect landing with greater ease and safety than any pilot could-and in any weather.

For something new has been added to the automatic pilot to make possible letdowns of such uncanny accuracy. It is a supersensitive feeler, still experimental but already successfully tested, resembling a weather vane in appearance and operation Sticking out from a plane's nose or wing, it is sensitive to the aircraft's angle of attack.

This is the angle between a line drawn through the chord of the wing and the plane's line of flight.

That angle is not determined by the attitude of the plane. The longitudinal axis of an aircraft may be parallel to the earth, for instance, while actually the plane is slipping downward as well as flying forward. The angle of attack in this case would be the angle between a line projected through the wing and the direction of airflow caused by the plane's combined downward and forward flight.

When this angle increases beyond a certain critical degree, the flow of air over the wing is disturbed. The result is a loss of lift so great that the plane stalls. A stall is especially dangerous during a landing approach, in which a plane may lose altitude so rapidly



that it cannot recover. The result is a crash.

A plane's angle of attack is increased to the stall point by too heavy a wing load in relation to airspeed. Thus the stalling speed of a plane varies, depending on how heavily it is loaded. But the angle of attack at which any particular plane will stall is always the same.

Unfortunately, a pilot's judgment of angle of attack is very poor. He must therefore depend on airspeed to prevent a stall. To do this accurately requires data that are not always available in flight (such as reduced weight due to fuel consumption) and takes quite a lot of figuring. The result is that the pilot maintains enough speed to keep his angle of attack well on the safe side of the stalling point. This means, among other things, that he usually lands at greater speed than is really necessary—and a high-speed landing can be dangerous.

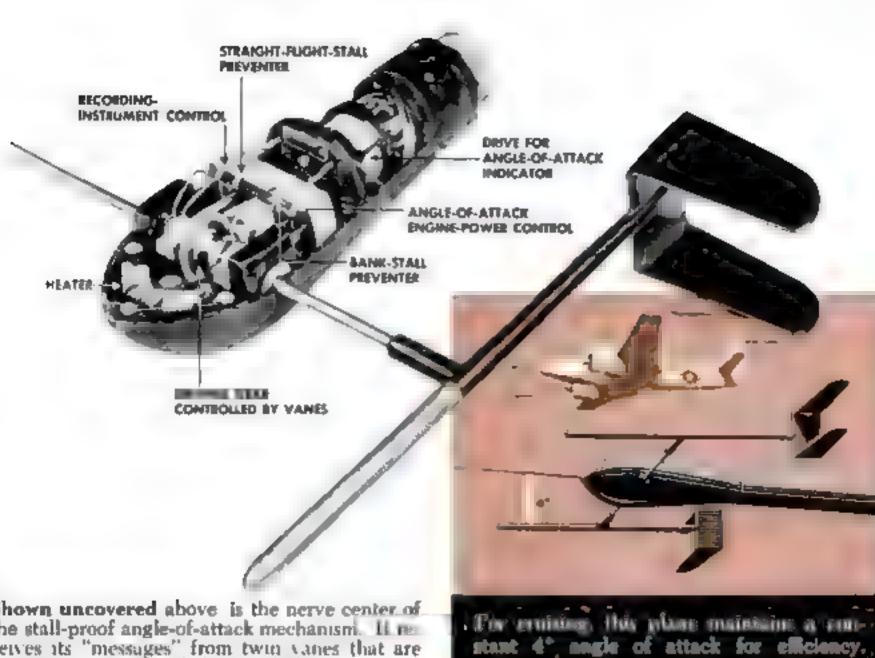
Now comes the Navy's new gimmick. It continuously and accurately measures the angle of attack and, by controlling the power delivered by the engines, can automatical-

ly keep the plane flying at just above the stalling point for whatever load it happens to be carrying.

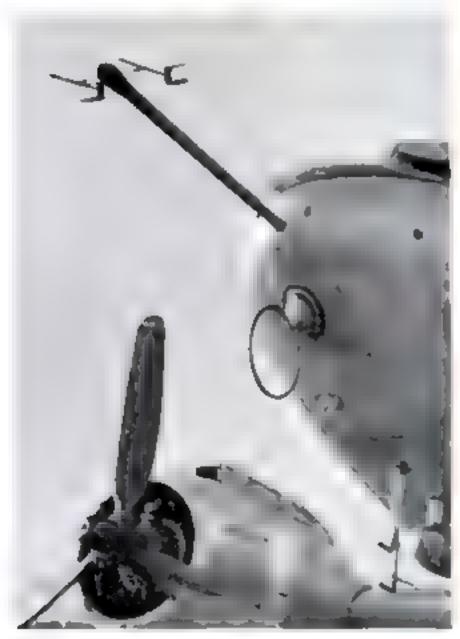
You can see how this would help in landing a plane on the short flight deck of a carner. For, with the angle-of-attack device, a plane can get to the very edge of the stalling point without any danger of stalling. By landing at a slower speed than the pilot would dare risk by just guessing, it hits the deck with less impact and needs less runway.

The new autopilot has been installed experimentally on an R4D (Navy version of the commercial DC-3). This plane ordinarily makes landing approaches at a minimum of 90 miles an hour. With the new angle-of-attack device, it can be brought in safely at between 70 and 75 miles an hour. With high-speed planes, the advantage would be much greater.

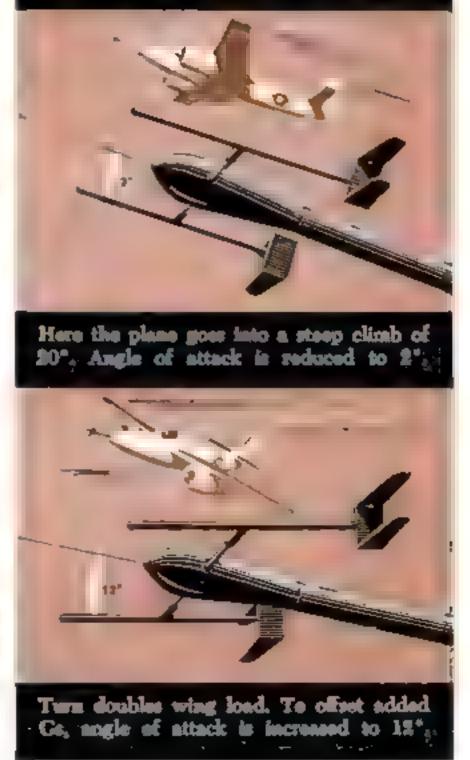
But the new device does much more for a plane than just keeping landing speed at the minimum. By manipulating other controls, as well as regulating engine power, it



Shown uncovered above is the nerve center of the stall-proof angle-of-attack mechanism. If me ceives its "messages" from twin vanes that are sensitive to the plane's line of flight.



Angle-of-attack "weather vane" installed in the nose of the Navy's R4D flying laboratory. Operational version probably will be smaller, highter, and installed on the plane's wing.



prevents stalling in any condition of flight.

Built into it are limiters, or stall preventers, set at a specified maximum angle of attack. Suppose that this safety limit for a particular plane is 18 degrees. If the plane approaches that stall point in a climb, and is already using full power, the limiter will send a signal to the autopilot's servo motors for elevators down. And the plane's nose will be lowered enough to keep the angle of attack within the set limit. If the plane approaches a stall in a turn, the limiter automatically nudges the aileron controls to reduce the bank angle and maintain a safe angle of attack.

Helps Plana Perform at Its Best

The new control mechanism also makes use of the fact that every plane has a most-efficient angle of attack for every maneuver. A chart will show a pilot his ship's optimum angle of attack for climb, glide, turn, and level flight. And the feeler, by showing him its actual angle of attack at any moment, will enable him to keep it performing at its best.

For cruising, angle-of-attack flying actually saves enough fuel to add miles to the range of a plane. Accurate control of the angle of attack to prevent stalling will enable jet fighters to hold the high ceilings at which they perform most efficiently. In combat the fellow who can stay at 38,000 feet while his enemy drops to 35,000 will have a great advantage

As a pilot-safety factor, the new automatic equipment can be adjusted to prevent a plane from going into violent maneuvers that would subject a man to G forces beyond human tolerance.

Angle-of-attack flying may even change the design of planes, permitting stubbler wings that would have too low a stalling point for safety under manual control. True, this might lessen the plane's maneuverability. But the day of dogfighting tactics is long gone. In another war, fighter planes probably will not even carry guns to shoot at other fighter planes. As supersome extension platforms for launching guided and other missiles at bombers, they would not need great maneuverability.

Installation of the stail-proof robot pilot on the Navy's fastest jet fighters, as well as on Navy planes of all types, is more than a possibility in the near future. At the Navy's Special Devices Center on Long Island, however, the project officer, Commander Edward F. Saxman, Jr., confined his comments to the experimental installation on an R4D flying laboratory. This equipment was developed by the Minneapolis-Honeywell Co., which is now working out improvements and ironing out bugs under Navy supervision. One job is to reduce its present weight of 140 pounds to an operational weight of about 60 pounds.

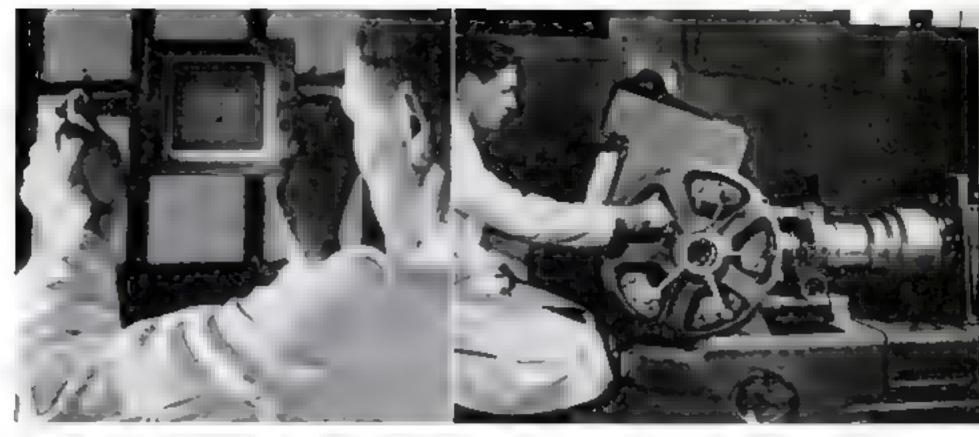
Development of robot equipment of this type indicates that the day of strictly handsoff flight may not be far away. When it comes, the pilot's job will be confined to
controlling prop pitch and fuel mixture,
plus putting down flaps and wheels on takeoff and landing. And even those chores may
be taken over by electronic fingers,

Tractor Attachment Builds Terraces the Easy Way

A ONE-MAN weapon against soil erosion, the earth-moving device, attached to the tractor below can throw up a mile of terrace in a day. As the tractor moves, a plow cuts a trench 10 mches wide and 10 mches deep,

throwing the loose dirt onto an endless belt. The belt, driven by the tractor engine, deposits the dirt in a ridge up to six feet away. The terracer was invented by William H. Tucker, a Marion, Kans., rancher.





Type Set Photographically in New Printing Process

Typeserring without type is made possible by a new British process called Rotofoto[©]. It's all done with pictures—photos of each letter. Text is first tapped out on the keyboard of a tape puncher. The tape directs the selection of individual letters from a master negative (above) carrying photographic images of all letters in a type family. The

text is then projected letter by letter in sequence on a 35-mm, film. A page-composing photoprinter (right) then combines the text image with those from four other films carrying headlines, subheadings, and corrected lines. Result: a transparency from which an ordinary rotogravure copper printing cylinder is etched.

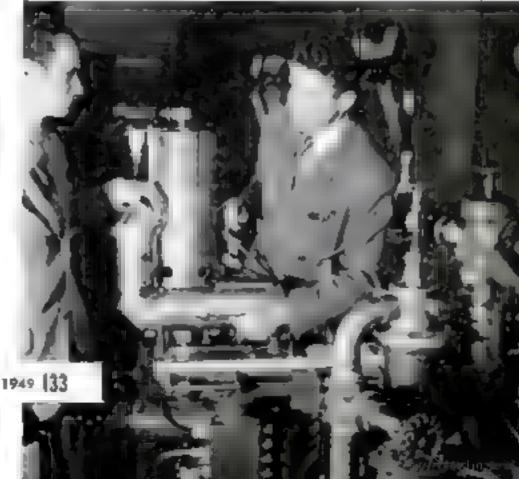
Hot Rings Test Motor Oil

RADIOACTIVE piston rings are helping to develop better lubricants for motorists. Irradiating a ring for a month in the Oak Ridge, Tenn., atomic pile turns part of its metal into ray-emitting iron 59. Handled gingerly, as below, the "hot" ring is inserted in an engine, which is run for three to four hours. Then a Geiger counter finds the amount of rubbed-off iron in the oil, an inverse test of lubricating efficiency. As little as one millionth of an ounce of metal worn from a ring can be detected.

Mightiest X-Ray Machine

X mays of 300,000,000 electron volts, the most powerful ever generated, stream from the world's mightiest synchrotron. Latest of University of Cahfornia atom smashers, the machine artificially creates the mysterious cosmic-ray particles called mesons, duplicating with electromagnetic radiation the feat of the University's 184-inch evolutron with speeding alpha particles. Below, Prof. Edwin McMillan, its inventor (left), and an associate adjust power supply to propel electrons at metal target, producing X rays.







PS reporter Devon Francis takes you for a ride in the world's largest air transport now in use.

NINETY of us walked up the ramp to board the Navy's grant Constitution for a nonstop flight across the country. Airplanes have carried more than 90 persons before, but never so fast and so far.

Ever since the Ford tri-motor appeared in the mid-twenties, I have been writing about "air liners." But the Constitution is the first transport that really lives up to the name. It symbolizes tomorrow's air travel.

It can tote 168 passengers. For comparison, the standard railroad coach seats 85. A railroad coach is about 9 feet wide, while the top deck of the Constitution is 11 and the lower deck 10. Together, the two compartments on the lower deck are 16 feet longer than a 69-foot railroad coach; the top deck is longer than a coach and a half.

We strapped ourselves in for the takeoff. The four 3,500-hp. Pratt & Whitney
engines coughed, caught, and roared. The
airplane waddled out to the downwind end
of the runway. She weighed, as she stood,
91% tons. That was a lot to get airborne,
even with her vast wingspan of 189 feet.

Slowly the rhythm of the engines grew. Our speed quickened. Then the take-off jets went to work. The floor tilted up slightly, the drumming from the runway stopped, and we were aloft.

The Constitution climbed fast. We soon topped 20,000 feet, and the altimeter was still winding up. Both upper and lower decks were pressurized to 10,000 feet. We began exploring the double-bubble fuselage

Aft was the women's lounge and forward ("toward the bow," explained the attendant) was the men's—as big as you'd find in a Pullman. Forward was the galley, the size of the kitchen in a 4-room apartment. In it were a refrigerator, racks for utensils, a two-burner stove, a grill for heating snacks, and long cabinets to keep 300 meals hot.

I wandered forward, past crew bunks and Sparks, busy at his communications, to the spacious quarters of the flight engineer. A four-dial flowmeter showed each engine was burning a gallon of fuel every 30 seconds. The 480 gallons of gasoline we were using each hour would propel the av-



Spaciousness of upper deck is shown above. In center is one of two stairways to lower deck,

Future Air Travel

erage automobile more than 7,000 miles.

In the nose were the captain and his first officer, deep in charts. Their crew was taking care of throttle and propeller settings: fuel mixtures; heat for the carburetors, the wings, fin, and horizontal stabilizer to pre-

vent icing; and the navigation

Except for some scattered Navy gear, the lower deck was empty. Along the sides of a deep well in the deck, half the width of the fuselage and fully 15 feet long, were intricate nests of tubing and wiring. Here were controls for four 15-kilowatt, 120-volt DC generators, turning out enough juice to supply 20 6-room houses, and tubing for three separate hydraulic systems. An axial-flow fan of 7% hp., turning at 5,600 r.p.m., was supplying 4,400 cubic feet of air a minute to the plane's interior.

To anyone who has traveled chained to an airplane seat for long distances, the spaciousness of the upper-deck cabin was inviting. The aisle was wide enough for two persons to pass without squeezing.

There was leg room to spare.

An hour from Washington National Airport an engineer from the Lockheed Aircraft Corp., builder of the Constitution, settled himself in the seat beside me. "Funny thing," he remarked, "but sometimes the pilots don't know when the wheels are on the ground in landing except by an indicator light, That's partly because of prerotation of the wheels. There are wind vanes on the tires to get them up to around half-speed. Then electric motors spin them to landing speed. That reduces the shock of the touchdown."

I put my tongue in my cheek. I had landed-whimp!-in too many big airplanes.

By now we had lost most of our 23,000 feet of cruising altitude and were preparing to land. An officer announced on the loud-speaker system: "On landing we will be 9 hours, 35 minutes out of Moffett Field, California. Our average speed will be 268 miles an hour for the trip,"

The glide flattened. Runway lights whizzed past the porthole. There was the merest tremor—and then the passengers burst into spontaneous applause.

"We can't be on!" I said.

The engineer grinned, "See what I mean?"

Davon Francis



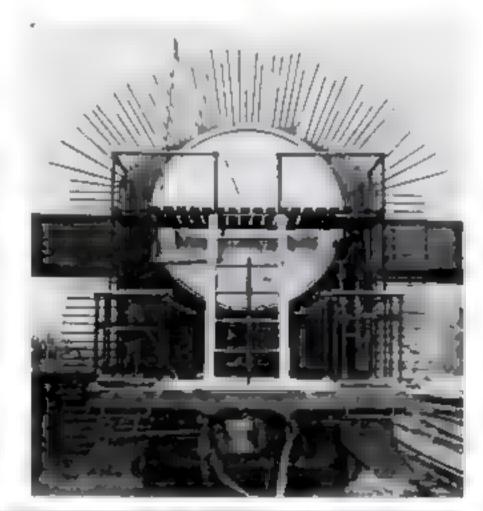
Street Has Three Decks

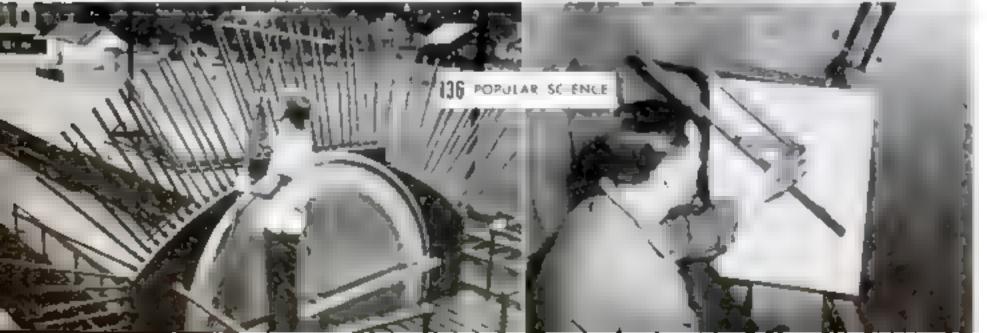
This three-layer street will speed New York City motor traffic unimpeded through a bottleneck between a steep cliff and the Brooklyn docks. Supported by a novel cantilever, the road on shelves will form a halfmile section of a highway to link La Guardia airport to the new Battery tunnel. The three decks, their undersides shaped to deaden noise, will provide north- and southbound expressways and a pedestrian walk.

Porcupine Car Feels Its Way

Is a railroad tunnel big enough or a bridge high enough to take a train with an extrahigh or extra-wide load? When the New York Central wants to find out, it dispatches the strange-looking car X800 shown at right to investigate. As the car goes through or under, the hinged wooden "feelers" bend back on contact with any obstruction. Later an arm is awang around them so as just to touch the tips of individual spines. This contour is recorded by a pantograph attached to the lower end of the arm and set in the circular plate at the end of the car. This is then translated into clearances.

Crew member at left below swings outside arm of recording device around spines. At right below, inside mechanism of the pantograph traces outline of the feelers on a sheet of paper.





NATIV Trains Rocketeers

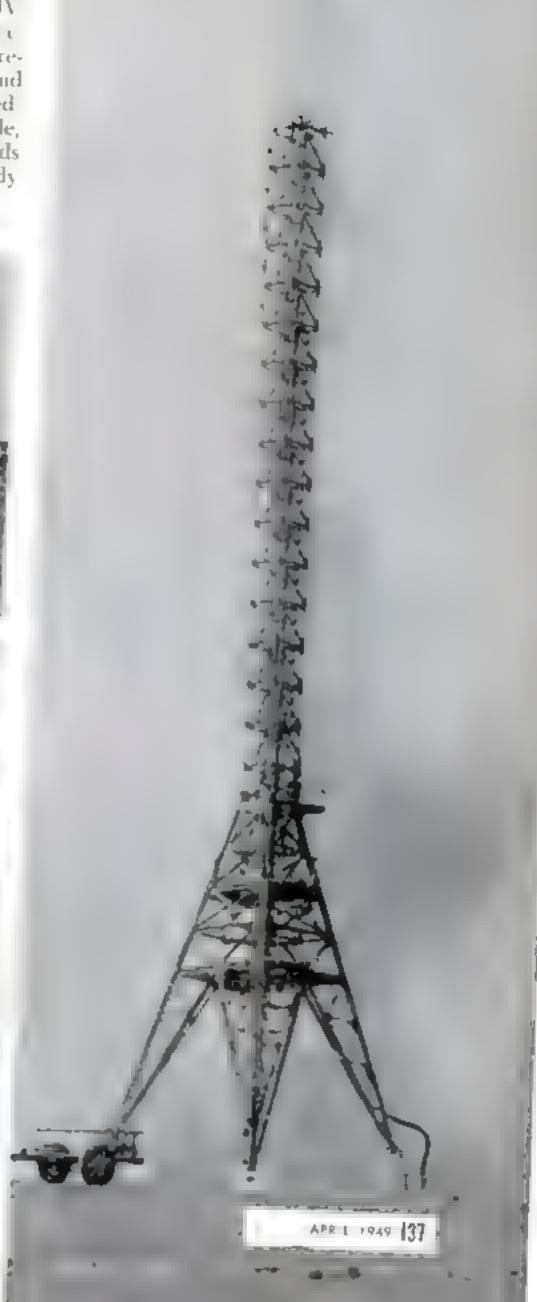
THE big rocket zooming straight up from the tower at right is the Air Force's newest guided missile. Called the NATIV for North American First Instrument Vehicle, it will be used for accidentative research, to devise better control systems and for training rocket largelling crews. Liquid finel meters drive the needle nosed missile, 13 ft, long and 18 in, in diameter, at speeds reaching the supersonic. It has already soared to more than 10 miles



Riding on its cradle to the banches tower the NATIV shows the four time. In is that provide controls during its goaded flight

Rucket is made ready, below for true; the eight special metal lacrebring tower whose ands grade to about during reduce seconds of flight.







Speciator's view of the crossroads village shown in GM's diorama. Exhibit is 22 feet

long, 7 feet deep. Area outlined in white is that shown in close-ups on the opposite page.

Motors Flip Model Town Into New Era

PS photos by W. W. Morris

Sections of the village are turned automatically, as shown below, by 68 telephone-type relays kept in phase with a narrative on phonograph records. Three-sided cams under the display revolve at 83% r.p.m., establishing 100 make-break contacts a minute. Since circuits are thus set on 1/100ths of a minute, animation can't get out of phase more than 6/10 second.

A DIORAMA that changes before your eyes to show the automobile's impact on a rural village is now touring the U.S. Twenty-eight fractional-horsepower elec-

Twenty-eight fractional-horsepower electric motors shift scenes in the three-ton exhibit, called the "Parade of Progress," to keep up with a story told by a narrator. As the story unfolds, three-sided sections are flopped over, one-third of a turn at a time, to reveal new buildings, roads, and bridges, as well as snappier cars.

For traveling, the diorama is loaded into a special 17-ton truck. It has been seen by a half-million spectators in the last few months. Owned by the General Motors Educational Service, it was built at a cost of \$40,000 before the war but had to be put in cold storage until 1948.

View of underside of diorama (below) shows one of the electric motors, with gears and chains for rotating sections of the exhibit, and chains of landscape yet to appear. Switch to start diorama action is closed by the phonograph pickup arm as the narrative record begins playing. The show's cycle is 14 minutes, during which 64 changes of scene take place.







Close-up of diorama at start shows the mack-

closely and you will see the sharply demed enthus at segments that change with story.



Period following World War I consist to year is narrative progresses. Concrete reads a new

tre tipe of body as and modernized are make press of the corrected began tra-

Today finds highways filled with 1949 ors New concrete bridge, spruced-up stores, to

I red theater, new post office, and fancy-parts service station change country's appearance



Propeller Copters Are Funny Birds



Three basic types of convertible planes are sketched above. Top one has separate rotor blade and propeller. In middle version, rotor blades pivot in mid-air to become propellers. Bottom one takes off vertically, then tilts over in flight to a horizontal position. At right and below are artist's conceptions of how these dual planes might look in flight.



Here we have a conventional-looking airplane with a jet rotor blade atop the fuselage. For forward flight, this blade is locked in low-drag position, and the regular propeller takes over.



Here the rotors for helicopter flight are pivoted from horizontal to vertical to become propellers for airplane flight. A small, experimental plane of this design is now under construction.



Another version of this type has been proposed by a French designer. As shown above, one rotor is placed forward and the other aft. They pivot to become a tractor and a pusher propeller

40 POPULAR SCHENCE

THE wedding of the heheopter and the conventional aircraft is a long way off, but even aeronautical engineers can dream—and in aviation, dreams have a way of coming true.

The ideal of the union is a craft that would rise vertically from your front lawn or garage roof, powered by a whirling rotor atop the fuselage. Then, at a safe altitude of a few thousand feet, this ideal aircraft would switch to horizontal, propellered flight at speeds of 450 m.p.h., or even faster if jet powered. At your destination, the switch

would be reversed for a leisurely vertical descent.

One of the main problems to be solved is the mid-air transition from 'copter to fixedwing flight. At that instant, the craft would be a "vagrant"—without visible means of support. But that's only one of the puzzles that enthusiasts of dual-purpose planes must solve with their slide rules and wind tunnels. So far, most experimental work has been confined to small models.

On these pages is a preview of how some of the air hybrids may look—and work. END



Similar in appearance, this version has propdrive shaft running through rotor blade. When blade is locked for transition, a swivel-mounted prop at blade's forward tip goes into action.



A full-scale Herrick Convertaplance was flown as early as 1937. In this version, a tip-jet rotor blade becomes a second fixed wing when stopped. Conventional flight is with pusher prop.



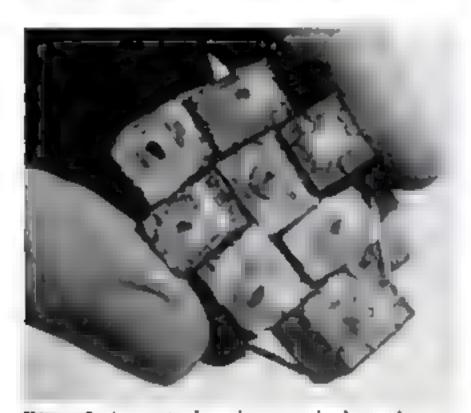
Three-pronged nose in the craft above is landing gent for helicopter take-off and descent. For horizontal flight, it folds in, the whole plane levels off, and the rotor becomes a propeller.



This streamlined variation also takes off and lands vertically. In transition from helicopter ascent the jet-topped rotor blade pivots and becomes the fixed wing for horizontal fight



Arrow points to one of genes in fruit-fly tissue enlarged 43,667 times by electron microscope.



Bits of tissue to be photographed in electron microscope are stiffened for slicing by unbedding them in collodion and parathn. Blocks are frozen by fumes of carbon dioxide from dry ice.



Slicing machine with new ultrafine adjustment presses imbedded tissue against sharp knife that shaves off layer only 1/250,000 in, thick. Operator watches through ordinary microscope,

1/250,000-Inch Slice Traps Genes for Camera

THOSE fantastically tiny particles, called genes, that determine such traits as the color of your hair and eyes, and whether you are a man or a woman, have now been photographed for the first time. The way this was done opens important new fields for medical research.

The first gene pictures were taken by two young scientists at the University of Southern California, Dr. Richard F. Baker and

Dr. Daniel C. Pease. Their achievement caps 50 years of efforts in laboratories all over the world to get an actual look at the mysterious carriers that transmit physical characteristics from one generation to the next.

Genes are smaller than the wave length of visible light. This meant that they could never be seen through an ordinary light microscope, no matter how powerful. That difficulty was overcome, in theory, by development of the electron microscope (PS,

July '48, p. 122).

Solving the first problem, however, only created another. The magnetically focused beam of electrons, which the super-microscope uses instead of rays of light, will not effectively penetrate a specimen thicker than about 1/250,000 of an inch. But the thinnest anybody had been able to slice animal tissue was only 1/25,000 of an inch.

How, then, to slice meat ten times thinner than ever before? Drs. Baker and Pease

managed that in two steps.

First, they imbedded the tissue in a block of paraffin mixed with collodion. Paraffin alone, previously used, was too brittle to slice ultrathin; and collodion alone was too elastic. Together they worked fine.

Second, the two U.S.C. researchers built an extra-fine adjustment into a microtome, a standard laboratory machine used to slice thin specimens of tissue for ordinary microscopic examination.

Hose Slicer Works

This attachment consists of a flat metal plate attached to the carriage of the sheing machine at a slight angle to its knife. When the crank handle of the machine is turned, a large pin slides over the angled surface and pushes the carriage a few millionths of an inch forward. The block of imbedded tissue then is pressed down on the knife, which shaves off a slice thin enough even for the electron microscope—and so delicate it must be handled with a camel's-hair brush.

For their first photographs of genes, the two scientists used cell tissue from a fruit fly. This insect is the favorite subject of students of heredity because it breeds successive generations 500 times as fast as

human beings do.

Fruit-fly genes, believed to be similar to those in people, turn out to be spindle-shaped particles about 1/100,000 cm. long

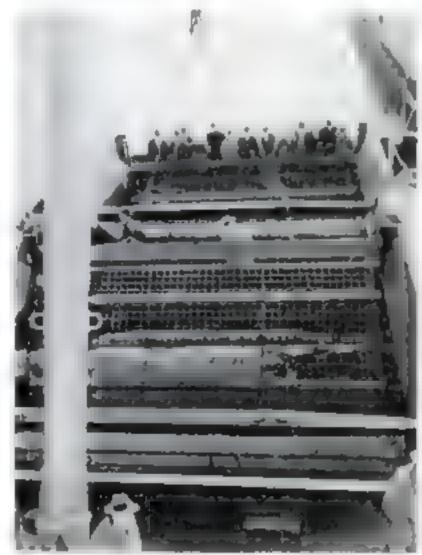
and 1/1,000,000 cm. wide.

But more important than those facts is the new slicing technique that made possible their discovery. A single red blood cell may now be sliced into 35 layers for detailed studies of its makeup. Internal details of bacteria and cancer cells will come to light under the bombardment of electrons. And by photographing slices of nerve cells, medical researchers hope to find out exactly where the virus of poliomyelitis—infantile paralysis—does its damage.



Port Sweeper Nets Debris

THE Army Engineers designed this odd-looking vessel, the Driftmaster, to keep New York Harbor swept clear of floating debris that menaces slup traffic. Driftwood is scooped up by two steel nets suspended between twin hulls bridged by the superstructure. One net at a time is pushed through the water with its lower edge just below the surface. When loaded, both are dumped by the crane into an incinerator barge. Two 300-hp. Diesels drive the craft.



Two nets are raised and lowered separately by hydrauhe gear. When forward net has been filled with driftwood, it is lifted up and second net is let down to skim surface.



Argument for Turboprops. Above is the world's first air liner to fly on propeller-turbine engines alone. It is the Vickers-Armstrong Viscount[®], Britain's No. I argument in favor of turboprop power for commercial planes. Advantages claimed are: that the engines give more power per

pound than piston engines; that, being smaller, they cause less drag and therefore give more speed; that they burn kerosene, less inflammable and cheaper than gasoline; that with lighter propellers vibration is lessened. The 32-passenger, 350-m.p.h. air liner is now undergoing flight trials.



Wing Tips Get New Job. Bulbs Australians Try Suction Wing on the ends of this Fairchild C-119 cargo plane's wings are not fuel tanks, but experimental radio-radar domes. Designed for the Air Force, the plastic wing-tip housings contain electronic equipment that ordinarily would take up cargo space. Each of the "radomes" weighs about 200 pounds. One holds radar units for aircraft detection and ground search in bad weather. The other, containing radio equipment, balances the plane and eliminates exterior antennas.



While high-speed jet planes are calling for thinner and thinner wings, Austrahan aeronautical engineers are experimenting with a thicker wing. Shown installed on a glider, it is twice as thick as that of a standard transport plane. As air flows over the concave part of the wing, part of it is sucked in through slots by a fan. The theory is that this will give added lift and jet thrust. Because of its thickness, the wing may prove suitable for all-wing planes.



Firepower Under the Wings. This is "Able Mable," the Navy's new one-man flying arsenal. She's the Martin AM-1 Mauler, and she carries the greatest fire-power ever packed into a single-engine, carrier-based aircraft. As shown above, 12 five-inch rockets and three 2,200-pound tor-

pedoes are shackled under the wings. Four 20-mm, cannon are built into the leading edges. The 350-m.p.h, plane is powered by a 3,250-hp. Pratt & Whitney Wasp Major® engine. It has a take-off weight of over 25,000 lb.—more than a 21-passenger, twinengine plane—and a range of over 2,000 mi.



More Power, Greater Speed. Four Allison turboprop engines will provide this Navy flying boat with more take-off power per pound of plane than some fighters. Sketch above shows the high length-beam ratio that will give the XP5Y-1 excellent hydrodynamic characteristics. Designed for long-range sea searches, rescue operations, and anti-submarine patrol, two of the flying boats are being built by Consultated Vultee. Their design was speeded by tests with a radio-controlled scale model.



One Engine Keeps It Flying. You wouldn't have to worry about getting home if one of the two 125-hp. Continental engines of this new executive transport conked out, as shown above. The plane is the Brigadier 2500, designed by Jack Bauman, of Burbank, Calif, and recently announced ready for production. The allmetal, pusher-type craft seats five people. Its range is 750 miles: cruising speed, 150 m.p.h. The plane's baggage space is so soony that coats can be hung up full length.



Shortstop for Jet Bomber. A parachute airbrake slows the Stratojet, world's fastest bomber, as its wheels are about to touch down on an icy runway, where wheel brakes are useless. The 30-foot

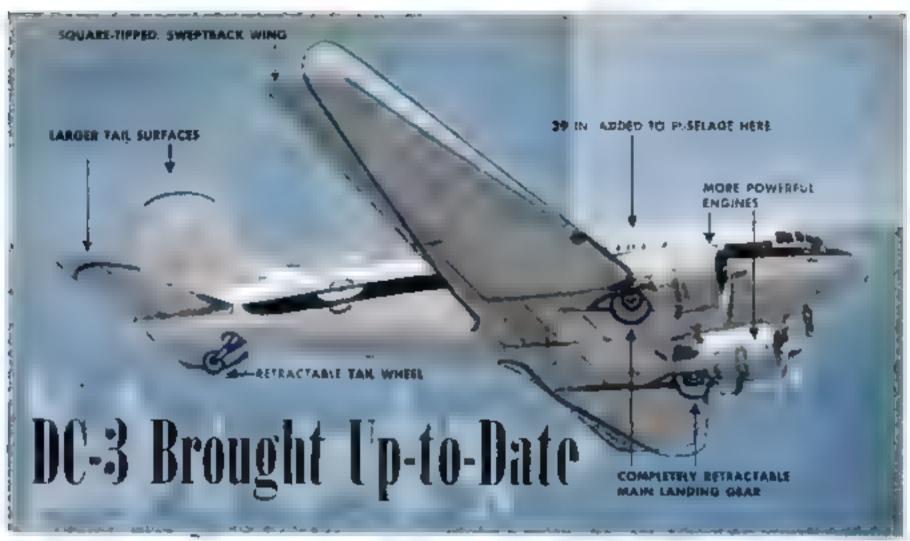
'chute is stowed in the tail of the 600-m.p.h. Boeing B-47 six-engine jet bomber and released just before landing. The idea was suggested by Major Guy M. Townsend, the plane's pilot in braking tests.



Check-Pilot in a Box. A new type of flight recorder, sensitive to altitude changes as small as 10 feet, is being adjusted above after a test run in a B-29 flying laboratory. Developed by General Electric engineers, the device also registers air roughness and operation of the automatic pilot and de-feing equipment. It is scheduled for experimental installation in the planes of several commercial airlines to provide increased information on flight operations from take-off to landing.



Jato Boosts Skyrocket. A jetassisted take-off sends the Navy's experimental Douglas D-558-2 aloft with a good start. Designed to explore flight at high speeds and high altitudes, the Skyrocket is powered by both jet and rockets. It climbs to high altitudes on its jet engines. The pilot then turns on rockets to approach the speed of sound. For landing, he switches back to jet power. The Jato bottles seen above attached to each side of the plane are dropped shortly after take-off.

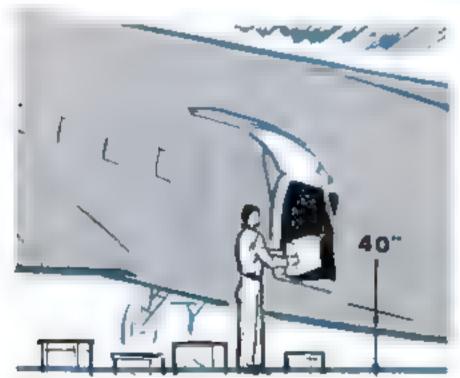


This is the faster, more powerful Super DC-3 air liner. The old version is outlined in color,

THE DC-3, famous old wheel horse of air transport, is getting a shiny new harness. The Douglas Aircraft Co. is offering civilian and military operators of some 6,000 of the twin-engine planes an overhaul from nose to tail. A choice of more powerful Wright or Pratt & Whitney engines will give the Super DC-3 a speed of 234 m.p.h., an increase of 45 m.p.h. A new take-off weight of 28,300 pounds, 3,000 pounds more than formerly, will boost passenger capacity from 21 to 31. Only outward differences will be 39 in, added to the fuselage, sweptback, square-tipped wings, and larger tail surfaces.



Eight divan sents in forward end of cabin, as shown above, are featured in 31-passenger version of revamped plane. Other seating arrangements accommodate 27 and 29 passengers.



Waist-level cargo door in the rear of the plane simplifies the handling of cargo and passenger luggage. Cargo door in the old version, located in the nose, is 10 feet off of the ground.



Built-in loading steps of the Super DC-3 do away with the cumbersome ramp that has to be rolled up to old plane at airports. This feature will save ground time at way-stations.

Chrysler Adds a Crash Pad, Keeps Detachable Fenders

Company's entire '49 line, including Plymouth and DeSoto, stresses safety, economy, and maneuverability.

By Devon Francis

THE Chrysler Corporation left one impression with the public when it exhibited its 1949 Plymouths, DeSotos, and Chryslers last month: that its foremost considerations were safety and economy

The funciest of the company's lines of cars, the Chryslers themselves, carries a leather-covered cushion of sponge rubber % of an inch thick across the top of the dashboard from the right of the instrument housing to the right door. Chrysler courageously stated that this was to keep front-

seat passengers from collecting bumps on their noggins in sudden stops. Another motor maker tried the same thing a few years ago and had to abandon it—frightened off buyers.

Like the '49 Dodge line (PS, March, p. 152), the new Chryslers, DeSotos, and Plymouths are lower, shorter, and narrower for easier and safer maneuvering. Yet their interiors are more spacious, and longer wheelbases provide a better-cradled ride.

Two items contribute to economy. One is detachable fender units. The company turned thumbs down on massive sheet-metal fender sections, welded to the body. On the reasonable assumption that fenders are bound to get dented, they are bolted on for easy removal. The other feature is stepped-



Pad along top of dashboard of new Chrysler protects front-seat passengers from bumps in sudden stops. Instruments are grouped in

semicircle over steering column. "Eyebrow" over instrument housing blocks reflection from windshield. Rotary switches replace push-pull type.



Wheelbase of this New Yorker® model is lengthened 4 in, to 131% in., but car length is shrunk more than 4 in. to 210. Saratoga® has same

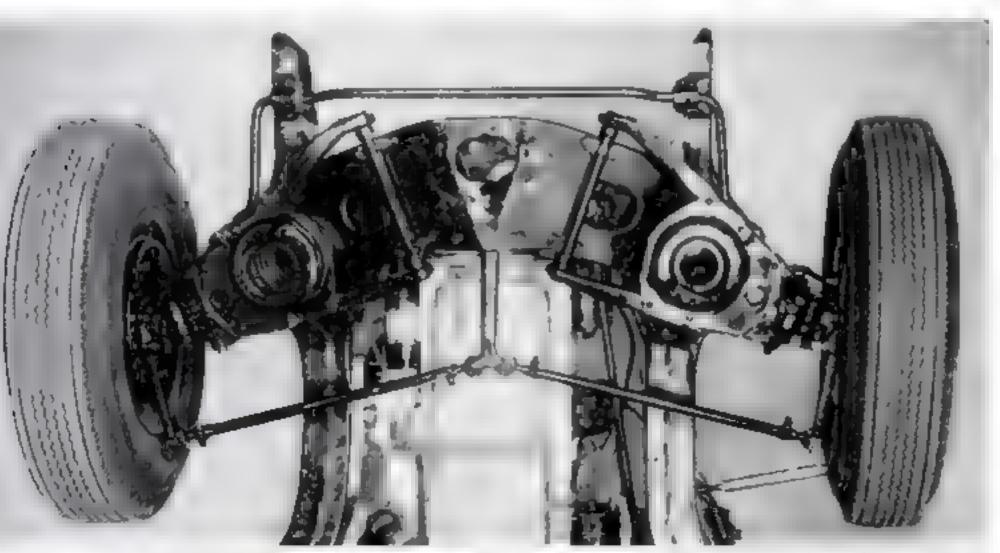
measurements. Wheelbase of Royal@ and Windsor@ is 125% in.; over-all length, 204 in. Cars are about 2 in. lower than last year's models.

up engine compressions for more mileage.
Recognizing theft danger, the new cars
have heavily armored ignition wire under
the dash to discourage short-circuiting.

The new Chryslers, called the Silver Anniversary® line, come in six groups and 22 body types with 6- or 8-cylinder engines. The Plymouth line has nine models; four Special Deluxe and two Deluxe types on a

118-in, wheelbase and three Deluxe types on a new 111-in, base,

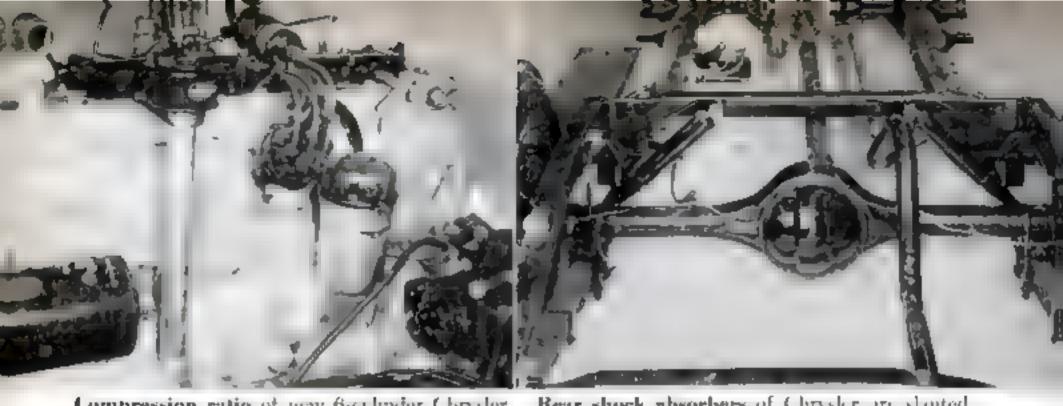
DeSoto also has nine models. Its Carry-All • sedan has a rear seat that can be folded flush with the floor to provide extra luggage space. While less radical than the Kaiser Traveler• (p. 106), this model is another interesting departure from conventional practice aimed at greater utility.



Dead-center steering geometry provints windwareacring and wheal light in Chrysian Static height of front springs is a jost if from 9a to

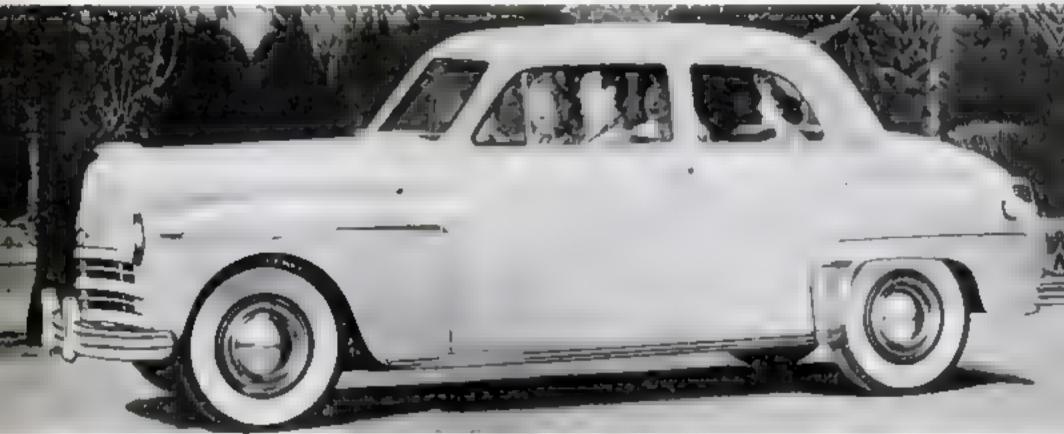
to 11 in. Bodies have new door-sill construction that increases torsional rigidity 25 percent Backup light is standard equipment





Compression ratio of new 6-cylinder Chrysler is necreased from 6.7 to 1 to 7-1. Ratio in 8s is 7.25-to-1, same is Ordsnobiles. Resistors in plugs and distributor out FM. IV interference

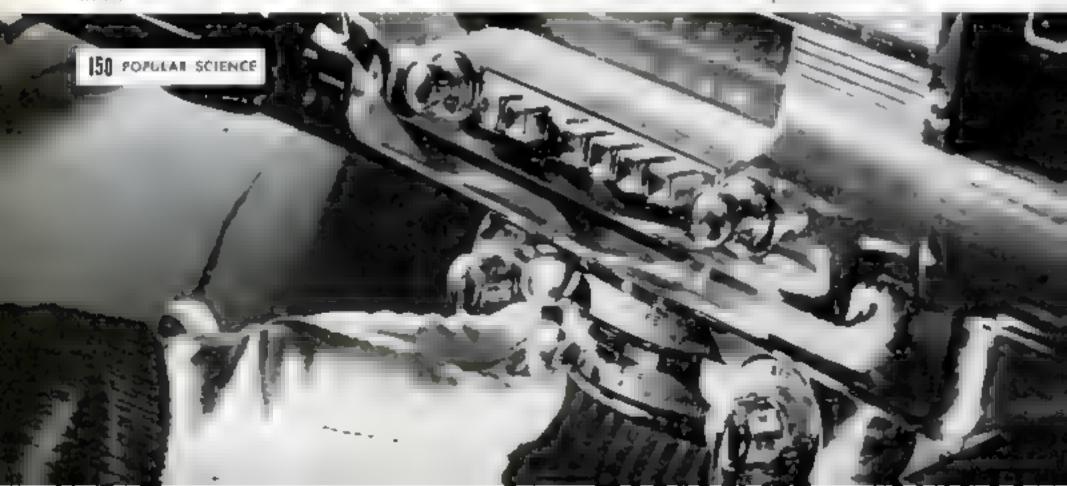
Rear shock absorbers of Chrysler are slanted it wird from spring at axle to from cross-menher. They used tishint forward. Attich ag shock to axle above spring factorses rose coarrings.



Streamlined 1949 Plymouth his 97 Lp. er gu c cescribes as suporter livelier more proportical Compression ratio is boosted from 6.6-to-1 to 7-1. Clause pister rings receive exhader wear

Fresh-air heater in Phynoptic steps up defrosting aid remayes we have for the warm weather at calche ascid is tresh air credator. Located image mode bester his controls contered under Frost cushion is will lead 5 to C. 56 in , retriction on 6 to 57 in Carbos out to at either. This view shows how to discuss by a lines and detachable blend into each bit will have

dish (below). New curs' whish elds and rear wildews are more than a third biggs. We puts clear made began and the front and trains its have three pillow customs.





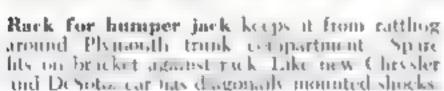
Combination switch for ignition and starter climinates starter butten on new Chryslers, Promouths and DeSotos Engine starts when key is juried sligatly beyond "ignition on" position



To reduce theft from parked cars models of all three Chrysler divisions have button that locks yent word as Plymonth windows open and close with half the handle turns formerly required



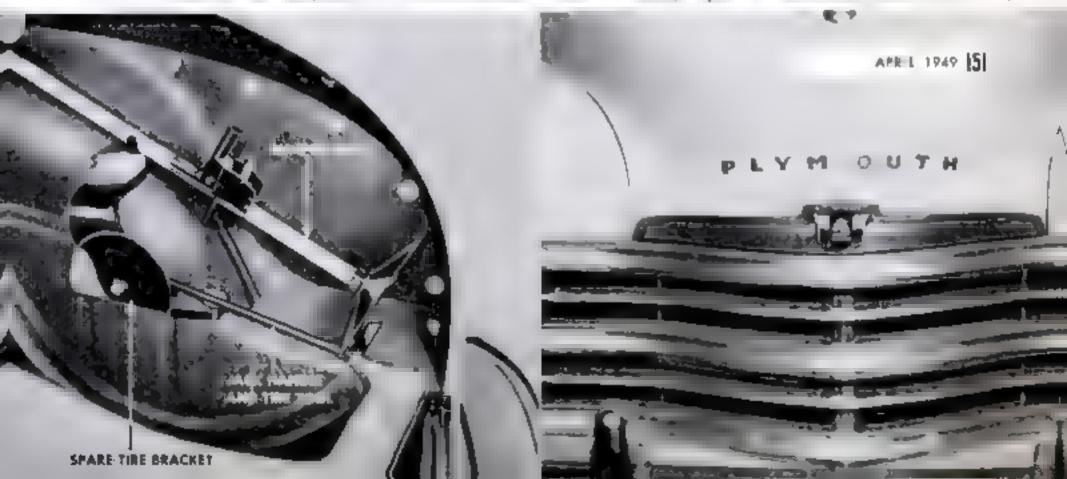
Plastic Jens on Plymonth tail light increases brightness by transmitting light through entire surface. Also on stop and parking lights, plastic resists breakage and gives better dust seal,

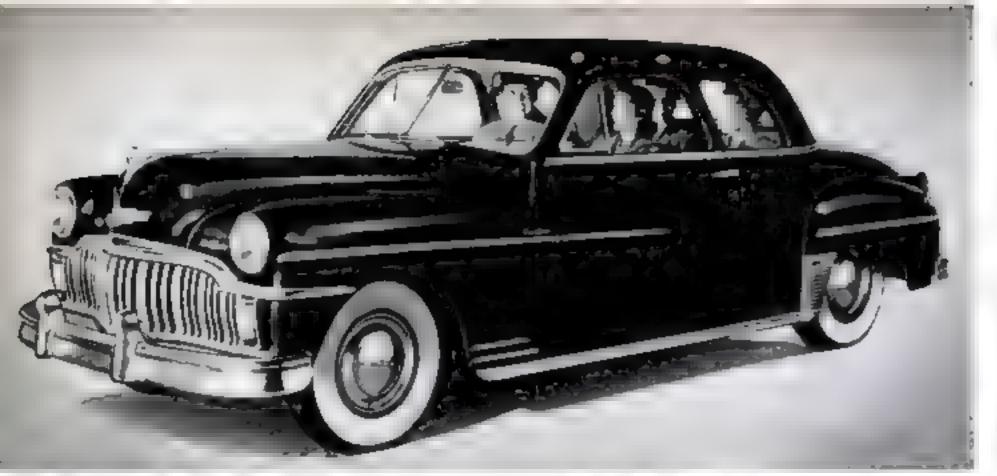




Bull's-eye lens in the center of the scaled-beam lens increases the output of light from head-heats. Luclosed circuit breaker in all of Chrysler hoes claimates reed to replace by the groses.

Styling changes in Plymouth are on conservative side-"common-scass streamhing." Sedins have rear door langed from center post to present swinging open at indatel ed accidentally.





DeSoto's Custom Club coupe is typical of models in 1949 line of this Chrysler division. Steering effort is reduced by use of "reverse custers," imparting a "leading" action to front

wheels. Gear-shuft control levers have been lengthened. Filter, gasket, and sediment bowl are eliminated from fuel pump. DeSotos have an 125%-in, wheelbase, an increase of 4 inches.

Girl Builds Cloud Chamber for Physics Lab

WHAT attracts a college girl? In the case of Joan Hinton, pretty sophomore at Bennington College, it was the electrically charged particles of nuclear physics. Result: her own version of a cloud chamber, the device with which scientists "see" subatomic projectiles by observing their tracks.

Miss Hinton's cloud chamber consists of two compartments separated vertically by a rubber diaphragm. Compressed air, valved into both, builds up a pressure of 7 lb. in the upper compartment and 9 lb. in the lower, so the diaphragm bulges upward.

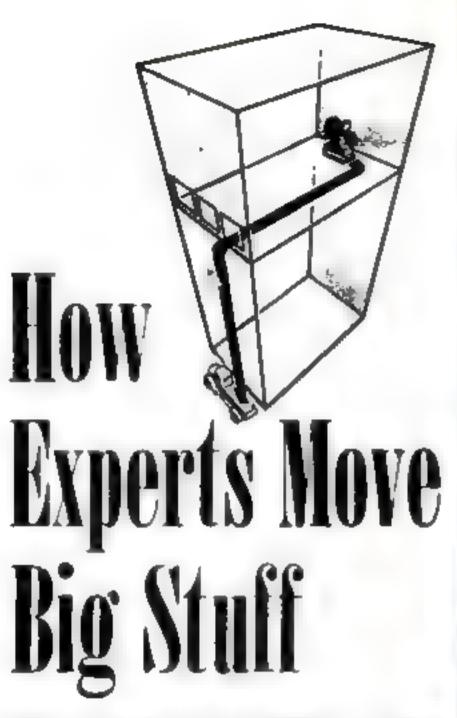
Pressing a switch then trips a pair of solenoids that open a valve and release air from the lower compartment. This lets the air in the upper compartment expand against the diaphragm. As the air cools from expansion, it can hold less water vapor. And the excess vapor condenses into fog on a string of air molecules ionized by particles shooting from a radioactive needle.



Physics students operate cloud chamber (left) built by college mate. Atomic bullets shoot from needle in glass cage above. Black velvet over mbber bottom aids photographing tracks.



152 POPULAR SCIENCE

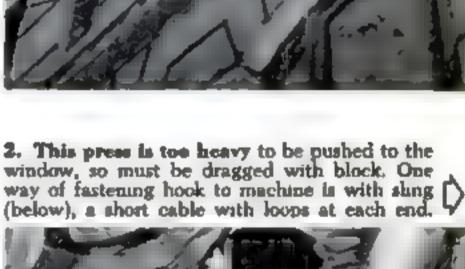


Riggers' tricks in lowering a 10-ton press from the 4th floor of a factory offer tips for farmers and mechanics.

PS photon by Hubert Luckett

1. Machine is lifted with aid of jack (below), after spikes holding it to floor have been removed, and pipe rollers are slipped underneath. Note that the skids are left on the machine.











3. One man can exert about 2 000 pounds of lorge with this type of black. When the press removes the block at well have to be turned around the extree and moved in a new direction.



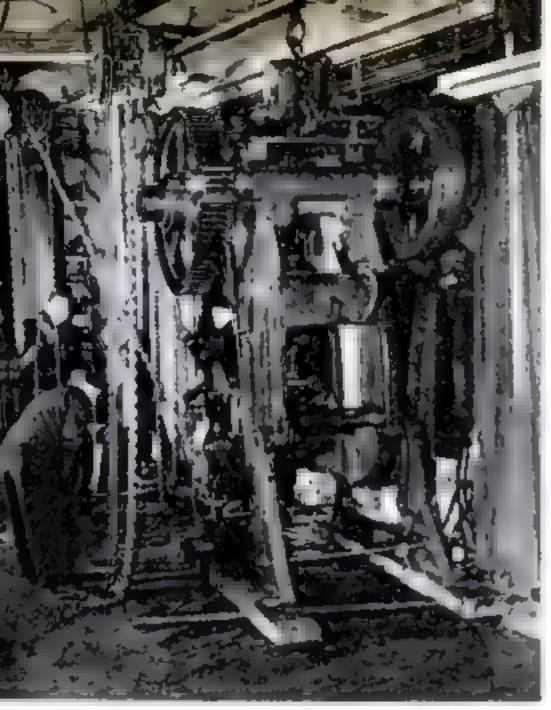
4. This general chain black does the work. It operates in either direction and uses a worm drive to prevent shipping. It is not bolted to the flaor but is lashed to a pidar of the budging.



7. The 10-ton lond wal be supported outside the building by a big block fustened to these trabers, which distribute the weight across four steel columns in the boulding wall itself.



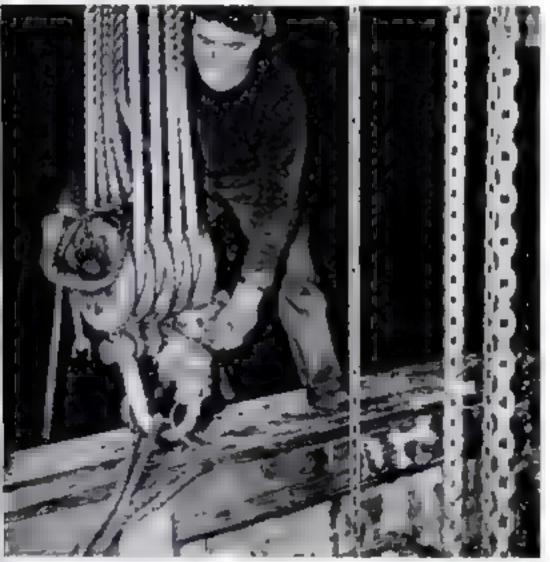
8. This four-fall block, set it the 11th Boor, lets the press rate slowly down from the fourth floor to the street. It is lashed to timbers that in turn are field to those in picture 7.



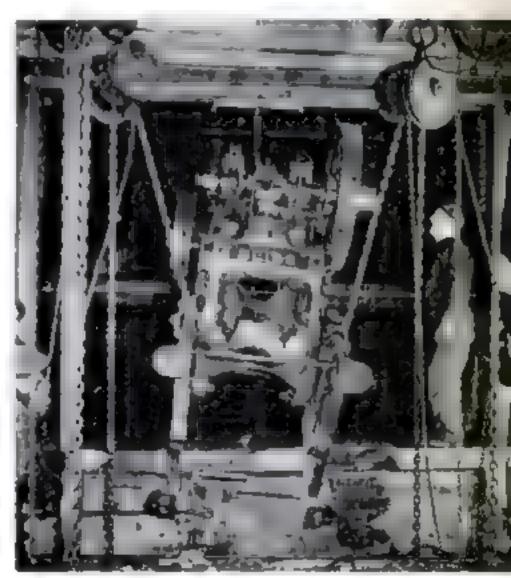
5. Blocks at window, strapped to ceiling I beams, pull press into final position. These blocks are set at the corners of a square, so that the press can easily be swung into any angle.



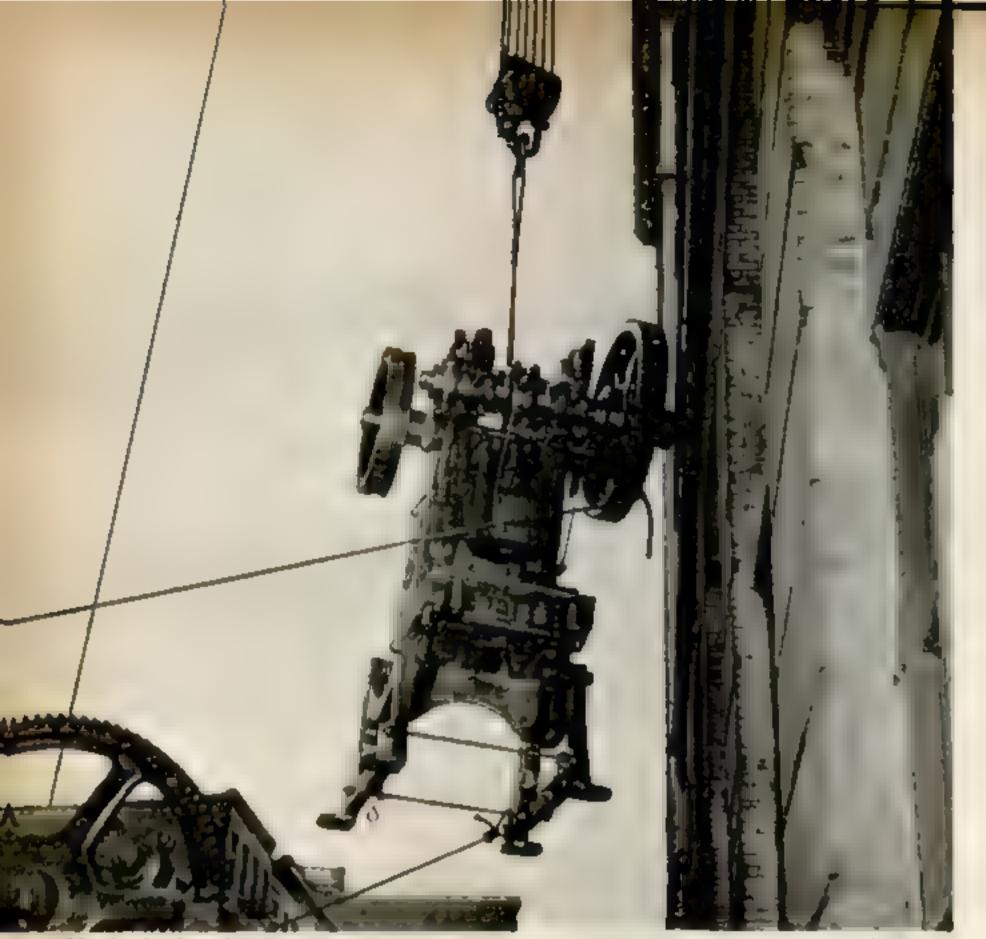
6. At the window, the claims are adjusted to lift the press up and out of the building. In this case the chains are simply looped around part of the press and hooked to themselves.



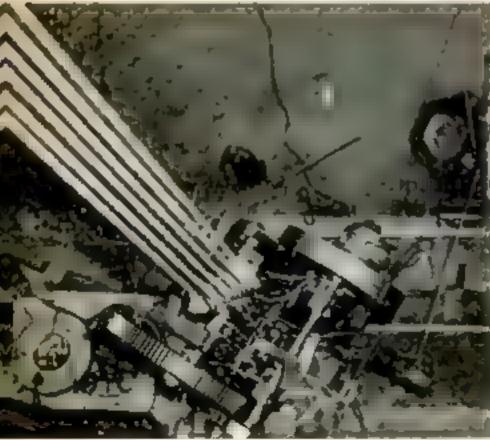
9. A traveling block is tied to the press The four sheaves in this and the 11th-floor block give a nine-to-one advantage, so that rope and capstan support only one ninth of the total weight



10. Most delicate operation is getting press, which is taller than the height of the window, outside the building. It must be lifted, tilted, and then swung out without damage.



11. As the four-full block lets the press down, guide ropes hold it away from the building.



12. Getting this 10-ton press to street was only part of Centre Trucking Co's job. It moved all the big machinery of the Colonial Metal Stamping and Spinning Co. in New York.



13. Capstan operator slowly pays out his rope, setting press gently down on trailer at right. It will then be lashed into place, all ready for trip to company's new plant in Brooklyn.

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Waste Gas Turns Desert Into Garden

AN ARIZONA farmer, annoyed by the noise of a Diesel engine he was using to pump water for irrigation, tried putting a muffler on it simply by sticking the exhaust pipe into the stream flowing from his well.

This not only quieted the engine—but, somehow, greatly boosted the crop yield. An inquisitive Diesel engineer finally figured out why: acid from the exhaust gas, absorbed by the water, fertilized the soil by neutralizing some of its excess alkali.

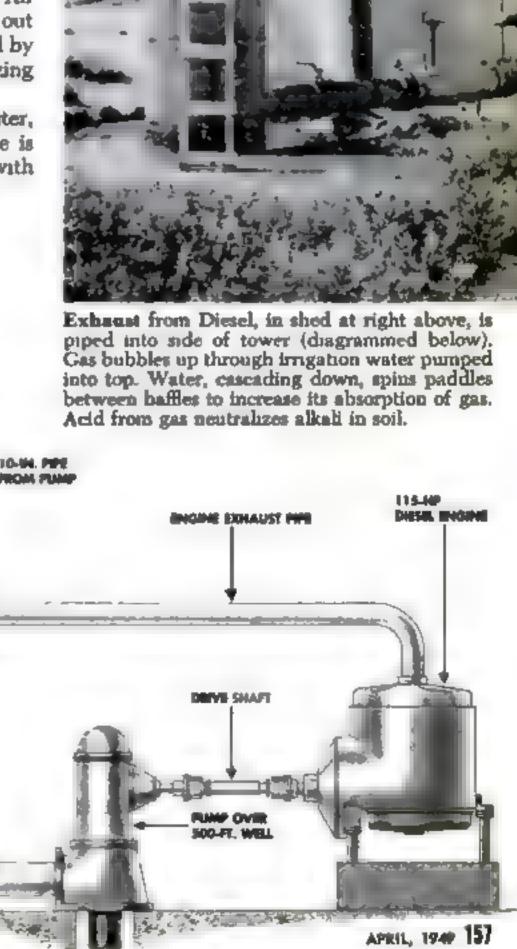
Now the engineer, Carl Sues, of Lancaster, Calif., has put his discovery to work. He is growing alfalfa in the Mojave Desert with the help of the apparatus shown here.

PLOATING BEARING

TO LIVESTOCK AND DOMESTIC USE

MAIN OUTLET

(UNIDERGROUNG)





You Spring from

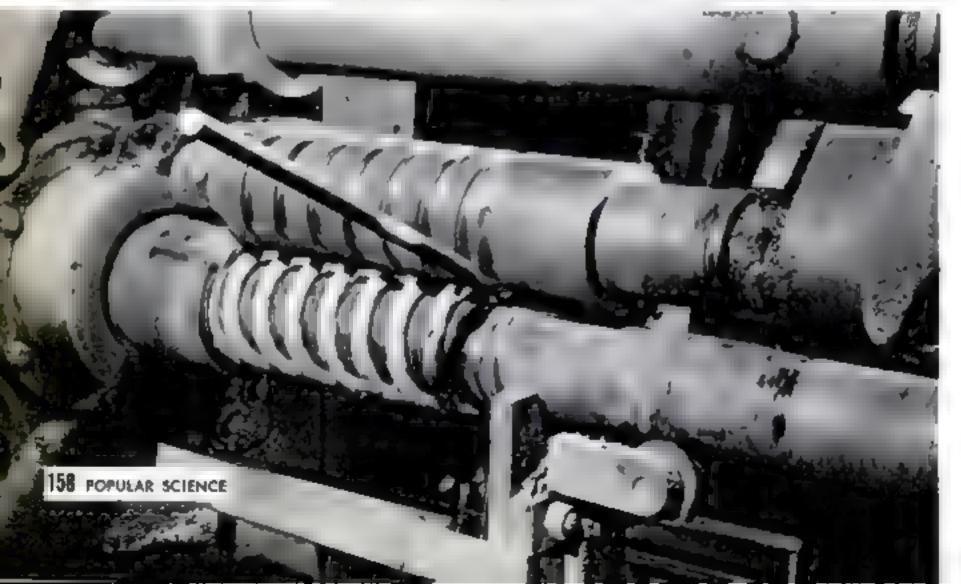
Here's the mechanical lowdown on springs—those silent, unseen forces that work for you thousands of times every day.

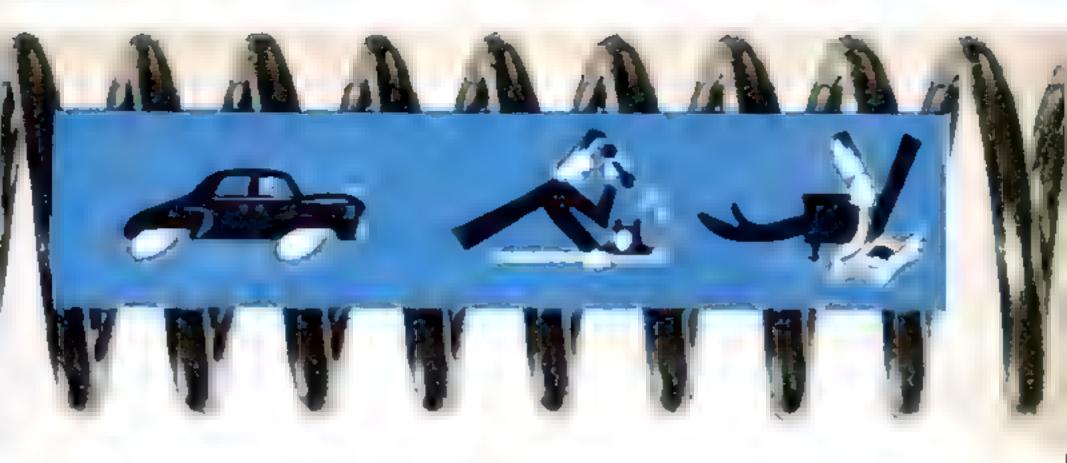
By George H. Waltz, Jr.
PS photos by W. W. Morris

YOU have depended on springs ever since your mother pinned your first diaper on you with springs in the form of safety pins.

A spring makes it possible for the alarm clock to wake you—even if it's an electric clock, because most of them have at least one spring on the spindle used in starting the motor. You get up from a bed made soft by as many as 900 separate springs. When you flip

Large springs are hot-wound. Spiral-grooved guide roller coils wire around a turning shaft.





Morning to Night

on the light in your bathroom, at least three more springs spring to your service. Every time you open or shut a door you use springs in the catches.

Your electric shaver contains still more springs, and the chances are your shower curtain is attached by a dozen or more springs in the form of snap hooks. When you dress you may put on a few springs in the form of tie and collar clips. Up to 80 more springs in

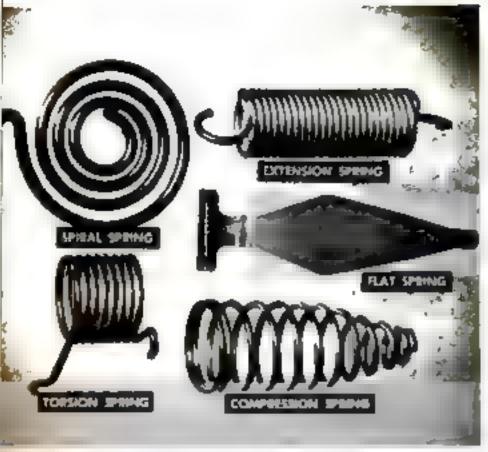
your toaster, ice box, stove, coffee maker, kitchen cabinets, and mixer-juicer may join forces to help prepare your breakfast.

Finally, when you start out in your car, you sit in the midst of some 250 assorted springs, each important to the car's operation. And by bedtime, according to your spring-driven watch, you're likely to have used several thousand more springs.

It had never occurred to me how many

Small springs, made of wire under % of an inch thick, are cold-wound on automatic machines.





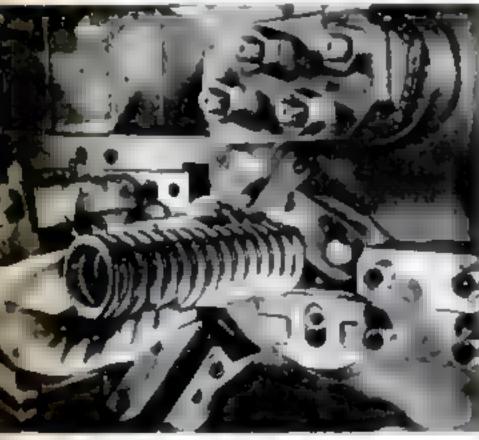
Despite variety of uses, these five basic types of springs do all the world's spring jobs.

springs I used until Bill Morris and I packed up the PS "prowl" car with cameras, flash bulbs, and other photographic gear and headed out to Lansdale, Pa., to visit the Hunter Spring Co. There I found that a spring is a good deal more than just a simple coil of wire. I saw springs being made in all sorts of shapes and sizes for all sorts of jobs. I came to realize, too, that there was a canny knack in making a spring that would deliver just the right tug or shove—from a featherweight force of a few grams to one of several thousand pounds.

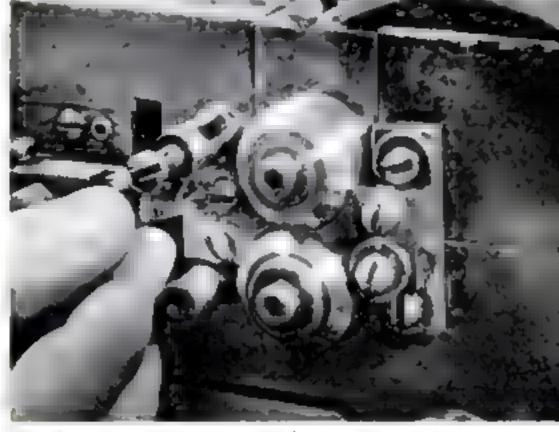
Yet, despite the many jobs that springs do, there are only five basic types:

The compression spring, which delivers a push-like the springs in a mattress.

The extension spring, which delivers a pull—like the kind that pops your toast up in the toaster when it is done.



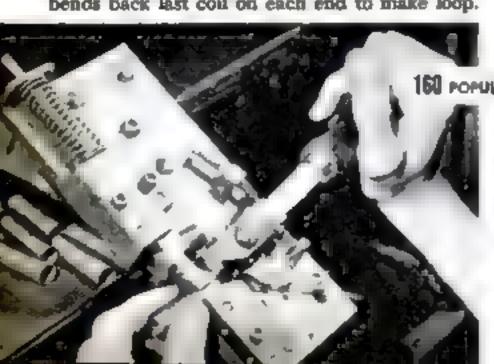
Cold-winding machines like one above are completely automatic. Three mechanical fingers inside, controlled by system of came, gears, and levers, coil the wire around a central arbor.



Small-spring winders are really miniatures of large-spring machines. Note tiny spring emerging from side like larger one in picture at left. Winder above makes 15,000 springs an hour.

Connecting loops on the ends of small compression and extension springs are formed in has I machine. Machine grips springs while handle bends back last coil on each end to make loop.

If springs require plating, they are placed in large, rotating, wire-mesh drums that douse them in desired plating bath. Many springs are plated to improve their appearance or durability.





The torsion spring, which exerts a twistlike those on the hanges of your screen door.

The spiral spring, which also delivers a twist but in its own plane—like the hair-fine coil that oscillates the balance wheel in your watch.

And the flat spring, which can be designed to exert either a push or a pull—like the leaves of the main supporting springs on your car.

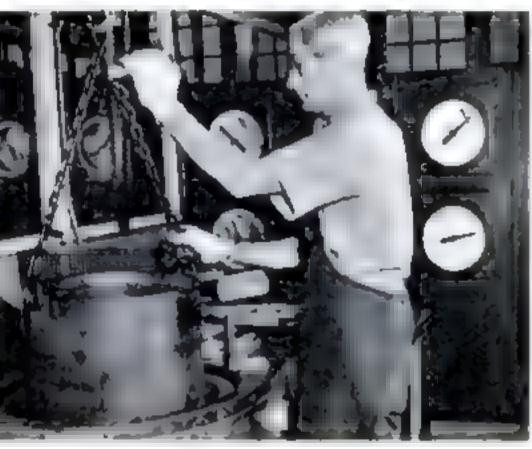
Springs were among mankind's first devices for storing energy. The early wars were fought with rough-hewn wood springs in the form of bows and stone-throwing catapults. Today, springs are "tailor-made" for uses the primitive inventor never dreamed of. But there's no such thing as a standard spring.

Each one is designed to strict specifications—size, force, shape, and life expectancy—and then carefully manufactured to meet those specifications. No product is produced with more meticulous precision or more careful testing than a spring that is to operate under strict tolerances.

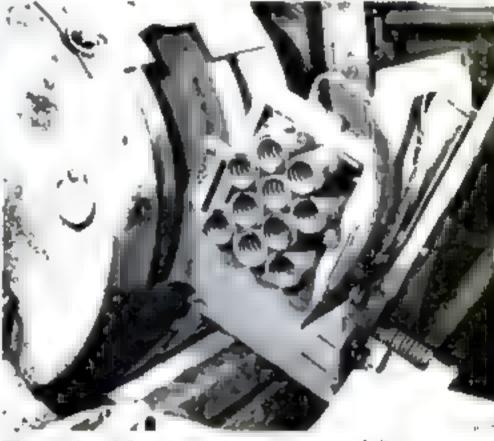
At one time, coil springs were manufactured on lathes by hand—the wire being wound around an arbor fitted into the lathe's head. This method is still used for special orders in small numbers. But most springs now are made by automatic machines.

There are two general processes; cold used for springs made of wire up to % in, in diameter. Hot winding, in which the wire is heated and then worked, is used in making springs from larger wire.

The cold-winding machines are completely automatic once they are set up to produce a spring of a certain size and type. This operation consists of installing the proper cams and gears in the driving mechanism, and



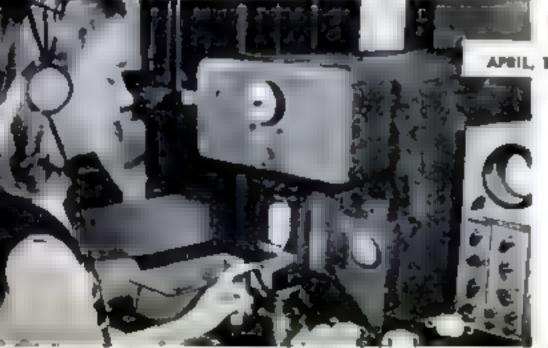
After winding, springs are heat-treated to remove any internal strains set up during coiling operation. Springs are lowered in bucket into furnace through circular opening shown above.

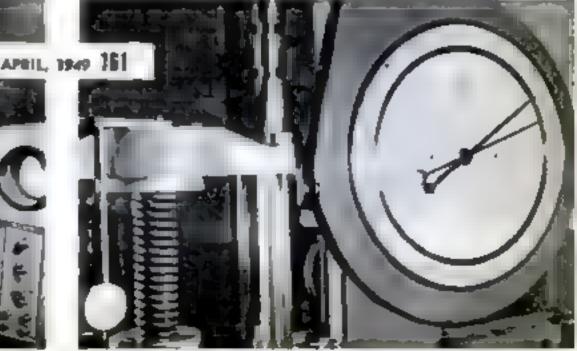


The ends of larger springs are ground flat to provide a good fit. Stack of springs, held in jig, is inserted between faces of two parallel grinding wheels so that both ends are ground at once.

Finished springs are carefully tested. Here device stretches springs for a washing machine. Faulty springs are detected by sounds in headphones and wavy lines on oscilloscope at right.

Powerful testing machines are needed for large springs. Here squeeze is being put on the big compression spring shown being made on preceding page. It withstood pressure of 825 pounds.





takes less than two hours. From then on the wire is fed in from a storage coil and the springs are automatically wound and cut to length. Machines of this type can turn out up to 15,000 small coil springs an hour.

The hot-winding process is more complicated because it requires heating and quenching. Rod stock, cut to the right length and tapered at one end, is first heated. A coiling machine then wraps the red-hot stock around an arbor. After coiling, the spring is quenched in an oil bath to produce the specified hardness. The best hot-winding machines can turn out about 200 big springs an hour.

"Tiny Tim" Turns Out Hairsprings

At the Hunter plant, springs are made of stock ranging from .004 in. to 7/16 in. in diameter on cold-winding machines. The machines, ranging from a Tiny Tim no larger than a typewriter to a mechanical twister about the size of a small car, turn out a wide variety of sizes, shapes, and types of springs. Mechanically, however, the smallest machine, which can produce coil springs that look like hair and exert a gentle force of a few grams, is no different from the largest machine, which can transform 7/16-in. rod into giant springs at a rate of better than one a minute.

In all cold-winding machines, three mechanical fingers, operated by cams, levers, and gears, wind the wire around an arbor, control the diameter of the spring and its pitch (the distance between coils), and cut it off to the right length. As one spring is cut off, the winding of the next is started. This may not seem like much of a trick with wire .004 in. in diameter; but when the largest machine is knocking out springs from 7/16-

in. stock, the pressures and forces are tremendous. Yet, to watch the grant coiler, it seems as if the heavy steel rod were bent as easily as so much macaroni.

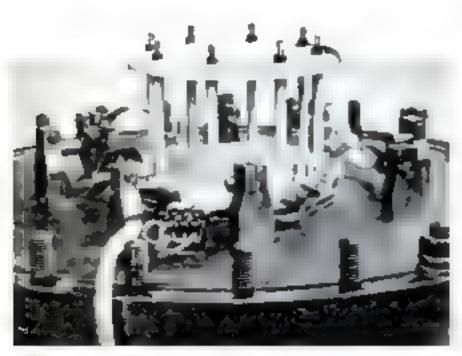
By adjusting the levers and installing the right cams and gears, the coiling machines can be made to perform any number of springmaking tricks: produce springs that are bigger at one end than the other; springs that start small, grow bigger, and get small again; and springs that have special ends. Even the pitch of a spring can be changed in the course of its length. And the coiling machines can do these things with an almost unbelievable degree of accuracy. They are even used to turn out the rigid copper tuning coils used in television sets.

A new spring is born on a designer's drafting board. By combining a knowledge of mechanics, mathematics, physics, and often chemistry and metallurgy, he creates its specifications. Design is important in a spring —it can cut weight and size to a minimum and boost accuracy and life to a maximum.

Some years ago, a manufacturer of pneumatic drills was having trouble with the springs on the mounting that held the drill bit. Under the best conditions, the spring would break after an hour of vibration. Today, thanks to good spring design, these misfits have been replaced with springs of just the right size, shape, metal, and tension. Now they last for the life of the tool.

Springs are precision items. Even the lowliest, like the safety pin, must be specially fashioned to do its particular job. "A good spring," says one spring expert, "is the result of close adherence to those 'tremendous trifles' known as tolerances."

Adjustable Springs Support Changing Loads



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Order specific loads, but the new ones at left can take a variety of loads. Developed by British Signals Research and Development, they are S-shaped bands of steel supporting the load at the middle. Their stiffness can be varied by simply compressing or stretching them. It can even be made zero—so no weight is supported—or negative—so they move the other way. Compressing only one side causes the bottom of the S to push upward more than the top pushes downward. When the upward push exactly equals the downward push plus the load's weight, the springs are in equilibrium, and the load "floats."





tractor is through a hole in the deck.

PARATROOPERS can pick up coded signals in invisible infrared light with the new viewer at left. A mirror on the underside of the cover, shown open, reflects the light into a lens that focuses it onto a phosphor. The phosphor gives off a greenish glow, seen through the eyepiece. A radioactive substance keeps recharging the phosphor.

Platform Speeds Tree Pruning

Trimming 100 acres of prine trees at

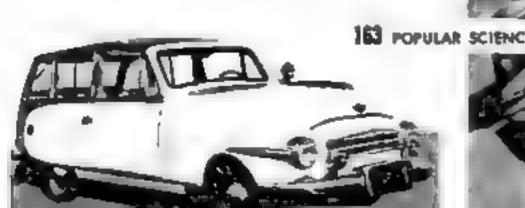
Windsor, Calif., was a long job until owners Don Du Vander and Pat Elsbree rigged up this tractor-mounted platform. Long enough to reach one side of four trees at a time, it can be raised to 12 feet for high branches. Catwalks permit close-in work. Access to the

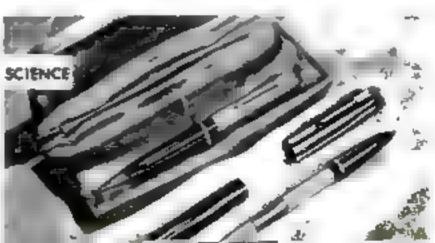
Station Wagon Is New Size

SMALLER than standard models, yet larger than the midgets, this flashy new Playboy station wagon introduces a light middle-weight class into the station-wagon field. Weighing 2,350 lb., it seats five persons, with roomy storage space at the rear. It has a 96-in, wheelbase and an over-all length of 163 in. Its four-cylinder, L-head engine develops 48 hp. Expected to come out soon, the station wagon will cost about \$1,500.

Pen Writes at High Altitudes

Air travelers can take along this new Parker "51" pen without fear of its leaking. What's more, it's said to write well up to 35,000 feet. A tiny, valved "breather" tube connected to the ink reservoir allows air to escape without pushing ink out ahead of it as the outside pressure decreases at high altitudes. The reservoir is insulated against temperature changes by an air space between layers of aluminum and Pli-Glass[®].





Oil-Well Nuisance Becomes Dry Ice

THE oil wells that already gush raw material for scores of everyday products, from fuel and rubber to medicine and soap, are now the source of still another commodity. This time it is dry ice—frozen carbon-dioxide gas that is so cold you don't dare touch it with bare hands. It fills such varied jobs as preserving blood plasma, testing airplane equipment, and keeping ice cream hard.

Dry ice has been made for years, sometimes from almost-pure carbon dioxide found in underground pockets. But carbon dioxide also comes up from some oil wells, mixed with the natural gas that often accompanies crude petroleum. Then it is a nuisance.

This is what happened in the Union Oil Company's wells at Santa Maria, Calif. Until last year the carbon dioxide had to be taken out of the natural gas and blown away into the air. Now a new million-dollar plant there is using most of this waste.

The new plant removes carbon dioxide from the natural gas by the Girbotol® process.

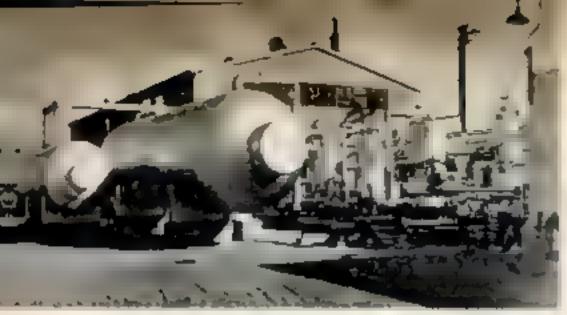
In tallest tower (below, left), carbon dioxide is removed from natural gas by dissolving it in

developed by the Girdler Corp. A chemical called mono-ethanolamine streams down a tower while the mixture of carbon dioxide and natural gas flows up the tower. The amine chemical absorbs the carbon dioxide without affecting the natural gas. From the bottom of the tower, the amine, now containing absorbed carbon dioxide, is pumped to another tower, called a stripper. There it streams down again, but against an upward-moving mixture of hot amine and water vapor. This process releases the carbon dioxide, which is pumped to the dry-ice plant.

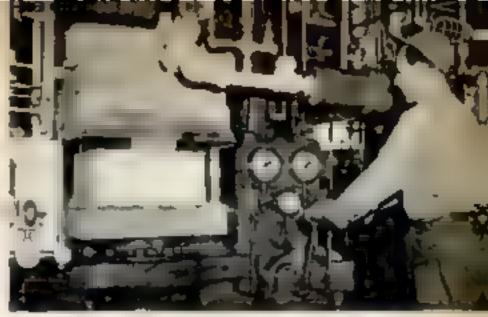
There the carbon dioxide is compressed and cooled until it is a liquid under 1,100-lb. pressure. The pressure is then released a little bit at a time. Each time pressure is let off, some of the liquid changes to vapor. This vaporization absorbs heat from the remaining liquid, so that the liquid becomes colder. Finally it freezes into carbon-dioxide crystals, called snow. Hydraulic plungers then compress this snow into cakes of dry ice.

mono-ethanolamine solution. Next tower frees the carbon dioxide from the mono-ethanolamine.

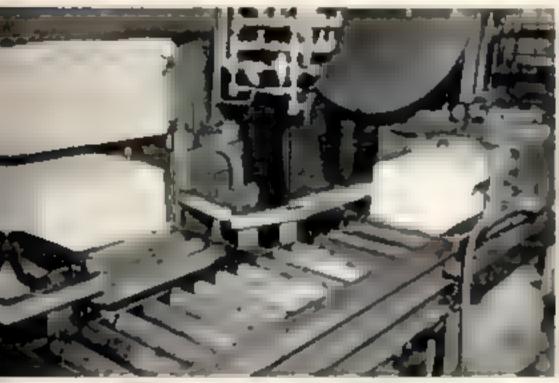




Large tank at center, above, is one of several holding purified carbon-dioxide gas during the stages of compression, cooling, and expansion that change it to so-called snow at -190° F.



Snow, obtained by releasing pressure on liquid carbon dioxide, is compressed into 240-lb. dryice cake by hydraulic press. Original volume of snow is reduced thousand-fold by the press.



While one dry-ice cake (left) is waiting to be pushed onto the rollers, another (right) is being cut by band saw. Two such saws are used to slice the big cakes into pieces 10 in, square



After being out to size, the cakes of dry locare wrapped in heavy manife bags, scaled with tape, and weighed on an automatic scale. The conveyor then takes them to storage or shipment.

These big storage bins (below) hold the pack ages of dry ice until they can be loaded into rail-road freight cars. The bins are insulated and sealed with wood and heavy galvanized iron.

Plant official points out 8%-in thickness of insulated door on specially built freight car (below) used to transport dry ice Car holds 1,155 cakes with total weight of 69,000 lb.





Swedish motor schooner Albatross tested new ocean-bottom corer on recent 15-month voyage. The ship, a new 1,450-ton training vessel, was air-conditioned for this tropical cruise.

The new-type corer, capable of pulling 47-footlong plegs from the bottom of the sea, is adjusted during the trip by its inventor, Dr. Borge Kullenberg, and the trawing master, Axel Jonasson



Apple Corer'

Tubular knife on a four-mile string "plugs" sea floor for cross sections of sediment millions of years old.

MILLIONS of years of history now can be pulled out of the bottom of the ocean. It's done with an automatic "apple corer" that works on the end of a four-mile string. The cores it brings up are cross sections of sediment, from which scientists can fix the dates of great volcanic cruptions, earthquakes, and ice ages that occurred long before any one spoke English on this bit of the universe

Evidence like this may also help tell whether the American continents were once joined to Europe and Africa. One theory suggests that the Americas drifted away, leaving a big basin that has become the Atlantic Ocean. Other geologists say that the oceans now are pretty much the way they have been ever since the earth was formed.

Newest of the ocean-bottom "apple corers" is one invented by Dr. Borge Kullenberg, a Swedish scientist who adapted it from a device used by the Swedish railway system to obtain samples of ground along prospective track routes. It can pull longer plugs than any other device, thus providing more information in a single sample.

How Sampler Works

Called a piston core sampler, it consists mainly of a weighted, brass-lined steel tube about 20 yards long with a close-fitting piston inside. As shown in the sketches at the right, counterweights dangle from one end of a lever, balancing the tube, which is loosely hooked to the other end of the lever. The counterweights hang slightly lower than the end of the tube, so that they hit the ocean bottom first. This lets the lever swing up and drop the tube.

The weight of the tube drives it into the ocean bottom. The piston, however, remains fairly stationary, creating a vacuum that helps pull long cores into the tube. Doors like clam shells then close over the mouth of the tube to help the vacuum hold the core inside the tube on its long ride to the surface,

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Taps History

The piston sampler was tested extensively on the recent 15-month trip of the Swedish research vessel Albatross—which should not be confused with the U. S. oceanographic research ship Albatross III (PS, Feb. '49, p. 121). On that voyage the sampler brought up 250 cores, including the longest one ever obtained—47 feet long.

A glance at one of these cores shows it made up of many layers—something like a huge roll of varicolored candy drops. Yet it takes a whole year for Britain's Natural History Museum to complete analysis of just six inches of the sample.

How Secrets Are Unlocked

Secrets impresoned in the cores can be decoded in two ways. One method involves meticulous chemical analysis of each bit of mud, sand, etc., to learn the quantity of elements in the sample that were formed by radioactive change from other elements. Once the weight of a "daughter" element is known, it is fairly easy to date that part of the sample, since the time required for the "parent" element to create a given amount of "daughter" is known.

The other method is to identify the longdead animals and plants imbedded in the sediment brought up by the corer. Knowing when these fossils were alive, scientists can tell when a particlular layer of sediment was formed.

Many of the cores pose unexpected—and still unanswerable — questions. One raised hundreds of miles off the Atlantic Coast by Dr. Maurice Ewing, of Columbia University, contains a layer of sand. Sand is formed by the disintegration of rocks, but there are no rocks of that kind anywhere near the area where the core was taken.

That mystery and many others about the earth and its oceans may not be solved until many more plugs have been pulled out of the ocean bottom.

Vacuum action of piston in new corer helps pull long plugs into cylinder. Cylinder is released, driving itself into ocean bottom, when counterweights strike bottom and trip support lever. Piston remains stationary to create vacuum.





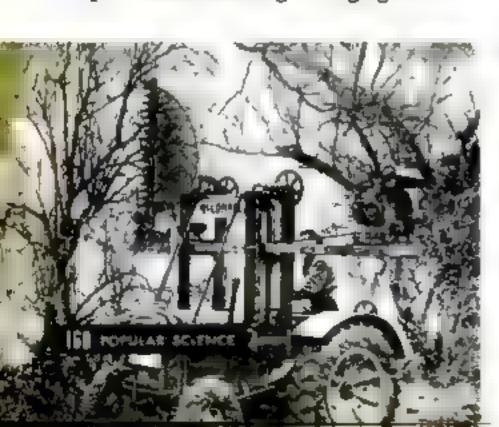
Walkie-Talkie Weighs 21/4 Lb.

MIDGET parts, including the two miniature tubes above, keep this new civilian walkie-talkie to a fourth the size of wartime military outfits. The "transceiver," with folding antenna, weighs only 11 ounces; a headphone and batteries, carried in a separate case, less than 2 lb. The set is made by Citizens Radio Corp., of Cleveland.



Bouncer Tests Car-Seat Fabric

This machine gives a car seat as much abuse as would a 175-pound man sitting down and getting up 200 times a minute. Nash Motors uses the device to test proposed seat-covering materials. A similar tester subjects the covering to sideways rub. To pass, a fabric must take 10,000 bounces and scrapes without showing damaging wear.





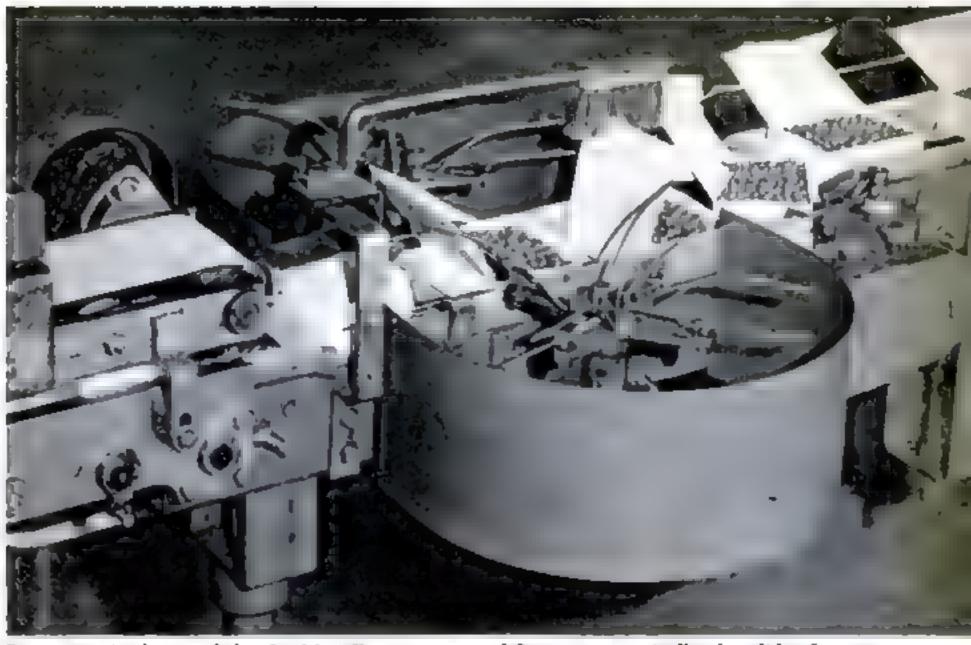


Phonograph Shows Pictures

As it plays a recording of a nursery song, this child's "television set" shows the story in colored pictures. A cardboard strip holding 17 frames of 16-mm. film is attached to a disk synchronized with the record. A lamp and mirrors project a frame every 11 seconds on a 4%- by 6-in, screen. Photo Electronic Co., of Chicago, makes the toy.

Motorized Mower Trims Hedges

An English farmer invented the tractormounted saw at the left to speed hedge trimming. A heavy-duty mower blade on one end of the crossarm is driven by a gasoline engine on the other. The arm can be raised or lowered and extended to the left or right. The hinged blade, besides operating vertically up or down from the arm, can be swung straight out to trun the tops of hedges. It cuts through branches up to about an inch thick.



Ingenuity is the word for food-handling machines. Here long-bristle brush and revolving

steel fingers automatically close lids of pea cartoos. Compression unit at left seals them.

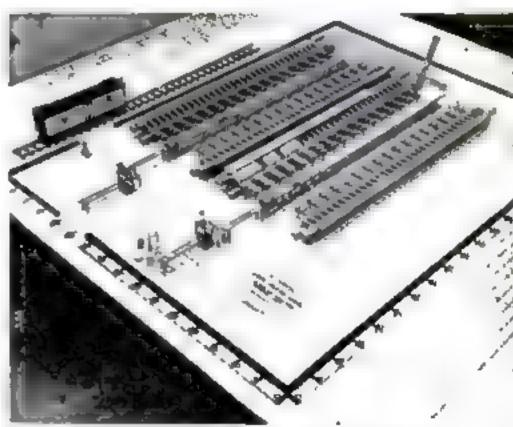
Mechanical Hands Prepare Your Food

By Andrew R. Boone

THE hands that can the peaches, squeeze the juice, and freeze the vegetables and meats you eat are cleaner and quicker than any human hands — however scrubbed and expert.

For big-scale food preparation has been taken away from the cook and given to the engineer. The push-button boys have learned how to make steel and electricity perform a thousand processing jobs, from squirting exactly enough oil into sardine cans to separating juice from rind oil when squeezing citrus fruits by the carload.

Operating near San Jose, Calif., is a new canning plant, designed by the Food Machinery Corp., that splits, pits, peels, cans, cooks, cools, labels, packages, and delivers a cling-stone peach into a waiting truck or boxcar in 45 minutes—at a rate of 9,000 cans an hour



New packing or processing plants are first laid out with models, complete in detail. Machines are then built to conform to most efficient plan. Model above is for grape-packing plant.

for each production line in the cannery.

A hydrauhe ram, shoving stacks of crates from wooden pallets onto a powered conveyer, starts the peaches moving. Another belt, running at right angles, picks up the crates in single file. A dumper lifts them up the side of a tall frame, then slides the fruit onto a third conveyer. From this belt, the peaches move over a series of rubber rollers that grade them for size.

Selected sizes ride still other belts to the pitting machines. There a thin saw splits meat and pit in half. Cuplike knives lift out the pit halves, Jostling along a shaker table knocks off the pieces, and the halves ride into the peeling machine. After jets of steam and a chemical bath remove the skin, cold-water sprays wash off the chemical and any remaining bits of skin. Then a sheer splits each half into seven segments.

Moving along another belt, the slices fall from pockets into cans. Just the right amount of syrup is added when the cans press upward on a lift table against a series of valves. The cans then ride into a steam box that preheats the fruit and drives out air. A sealing machine clamps on the lids. Climbing a conveyer, the cans slip through a rotating valve into a continuous cooker and cooler operated by one man.

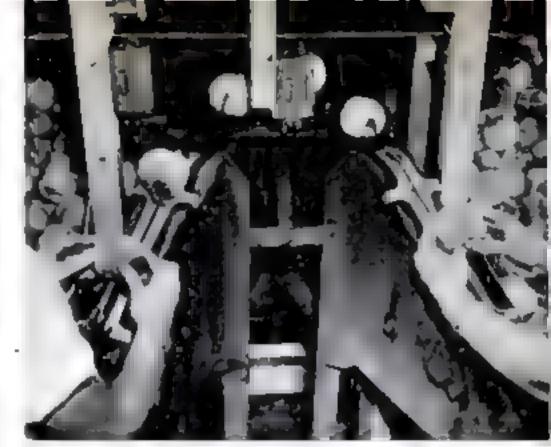
Cans Move Through Cooker

The cans worm their way toward the exit in a revolving reel. Eighteen minutes later, having cooked at 220° F, in a steam bath, they roll through another revolving door into a cold-water bath. To keep the hot cans from bursting, 25 pounds of air pressure is maintained in the cooler. Dried in a hot air tunnel, they are then labeled, packed in cartons, and rolled along a portable conveyer into a freight car.

That's only one of the most spectacular of the new food-processing robots.

In Rochester, N. Y., the Boutelle Manufacturing Co. has perfected a machine that will pit freestone peaches without ruining their tender meat. Across the nation, a California company has produced the Fill Master[®], a machine that fills 350 cans a minute with whole-grain corn, peas, and similar products. The Central Machine Works, of Philadelphia, and the Pfaudler Co., of Rochester, N. Y., have come up with similar machines that cram such semiliquids as creamed corn and apple sauce into jars or cans through multiple nozzles at the same rate.

And no longer is oil simply poured over



Peaches, after being forced onto razor-sharp blades by hand, ride into a pitting machine. Opposing cups pick up the fruit and feed it past a thin saw that splits meat and pit in half. Cuplike knives then lift out pit halves.

sardines. A vacuum-controlled oiler, devised by the King Sales and Engineering Co., of San Francisco, to suck oil among the little fishes, cuts as much as four months from the

soaking time formerly required,

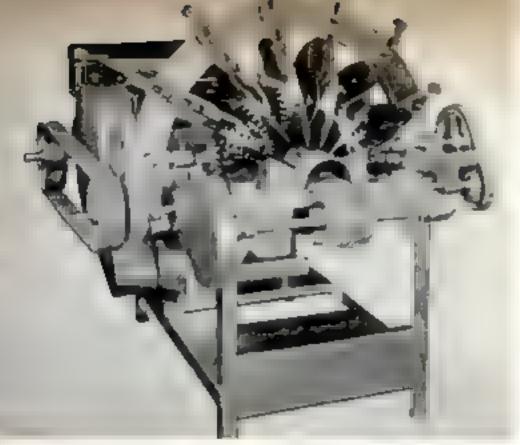
Until recently, most frozen foods have been chilled in tunnels that work like your home refrigerator. Because air is a poor conductor, the process is slow. It also requires considerable labor. Entirely different is Food Machinery's continuous freezer, illustrated on the opposite page. It turns out 85 packages of fruit or vegetables a minute.

Inice Frozen in Cans

Storage and transportation costs are being reduced by concentrating fruit juices to a fourth their normal bulk. Yet this is done so that they become palatable drinks when their water content is restored. At Dunedin, Fla., an ingenious tunnel built by the Salem Engineering Co. freezes solid 10,000 sixounce cans of concentrated orange juice an hour. Soon even segments of frozen fresh oranges and grapefruit will emerge from the big robot chiller in carry-home cartons—ready to be unchilled for fruit cocktails.

In other machines, just around the corner, cans will be dunked directly into refrigerants. Low temperatures rather than sterilization will preserve their contents. Production depends upon making sure that no refrigerant can leak into the cans.

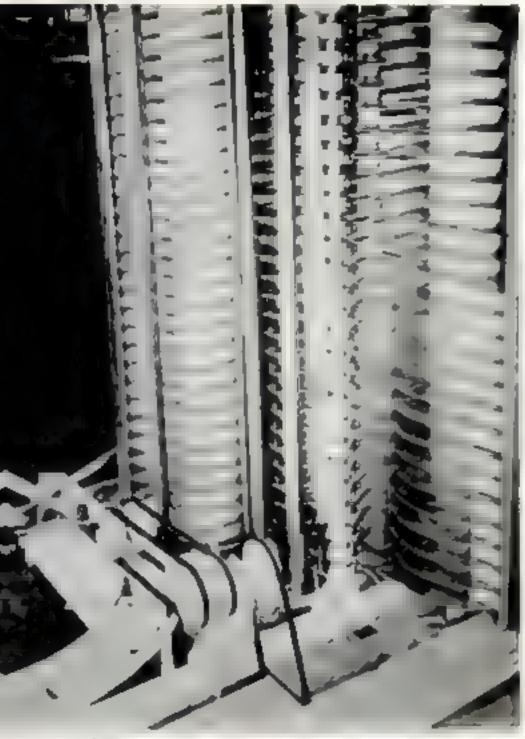
More and more labor-saving inventions are on the way to bring you tastier foods and pack them so they are more appealing on your plate.



Emerging from a peeling machine, many peach halves go to this slicer. An automatic device places each half, cup-side down, on a belt Spring fingers force the halves under six geared knives that cut each one into seven slices.



Taking the pits out of chemes is the job of this machine. After removing the stems, a steel plunger ferces the pits out. A soft-rubber cup then pushes the turn meat back into place—leaving the fruit looking intact.



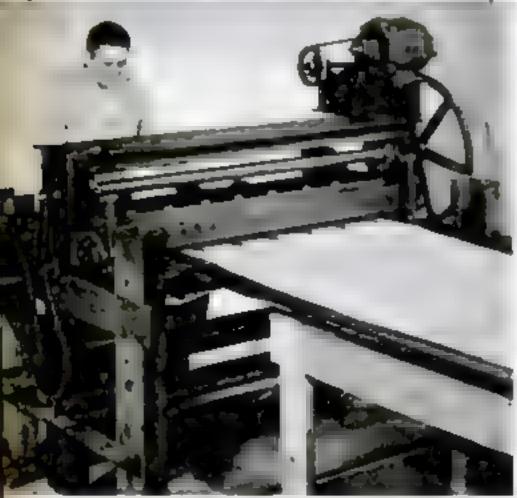
Packaged foods enter a continuous freezer along curved feed channel at lower left. Inwardly rotating screws lift packages into a vertical stack of 64. Guide bars push them between refrigerated plates inside the freezer. As they complete freezing circuit, another screw conveyer brings the frozen foods down to discharge line at lower right. The new machine saves time and labor



Sectional view shows hollow aluminum rails or shelves that form freezing walls through which packages are shunted inside continuous freezer Cold liquid ammonia (-28° F.) is pumped through dumbbell-shaped interior channels in rails. Food cartons, in direct contact with the chilled metal, freeze in one hour for dry items, up to 75 minutes for fruits in syrup.



Slit veneer, at left above, remains smooth and flat, while uncut sheet at right warps badly.



Veneer is fed through slitting machine in continuous strips, while guillotine-like blade makes short outs every % in. with the grain, leaving connecting fibers to hold the board together.

Driving Range Works Indoors

With the practice tee shown below, a golfer can start spring training indoors. The "ball" is a rubber pad on the end of a pendulum hung from the S-shaped arm. Thus the tee resets itself after each drive. The metal base may be bolted to the floor or weighted down. The device, made by Healthways of Hollywood, sells for \$2.50.



Slit-Sheet Veneer Saves Waste Wood

By splitting it thousands of times, waste wood has been turned into useful, money-saving wallboard. Called K-Veneer®, it is particularly adapted to prefabricated walls or sheathing. And it's said to be stiffer and stronger than insulation or gypsum board, or X-inch plywood as usually used.

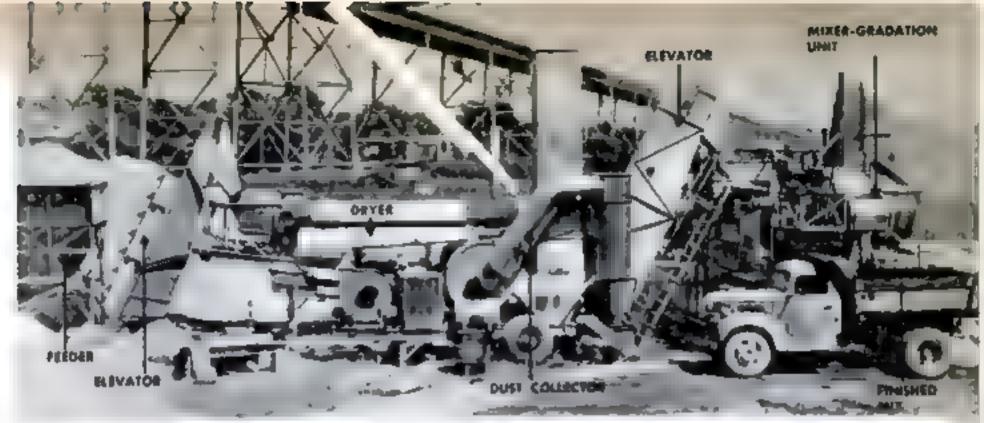
Logs unsuitable for regular plywood—too small, too knotty, or of inferior species—are peeled into sheets, then run through a slitting machine (left). The slitting takes out no wood, but stretches the board, increasing its width up to 10 percent. This gives room for the wood to expand internally, when absorbing moisture, without warping.

Once slit, the sheets go to a press. If for interior use, they are bonded to kraft liner board. For exteriors, they are faced with mineral-surfaced felt, thin steel, or aluminum sheets. K-Veneer has been developed by the Elmendorf Corp., of Chicago.

Squirt Can Douses Fires

BEING demonstrated below is a low-cost fire extinguisher intended mainly for farms, where several might be kept handy in out-buildings. The Hero[®], sold for \$1.29, contains 16 oz. of carbon tetrachloride under pressure. Lifting a ring at the top maps the tip off a spout—and out shoots a fire-dousing stream that carries 18 feet.





Utility asphalt plant is shown set up and in operation. The bucket conveyer at left loads

crushed stone into one end. At the other, the completed mix is dumped hot into waiting truck.

Asphalt Plant: Rides to Job On Trailers

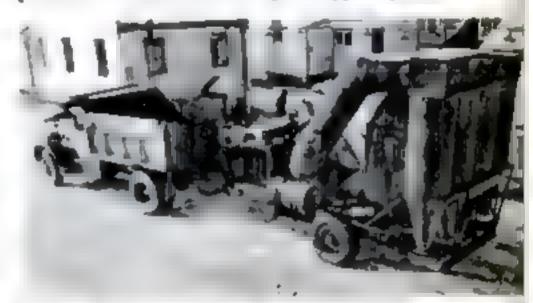
WITH this trailer-mounted bituminous mixing plant, road builders can now make their surfacing material right on the spot. Its units can be hauled over the road to the project, set up, and later dismantled in minimum time. Yet the ingredients it uses are precisely measured and the process kept under exact control.

Origin of the portable plant goes back to World War II when roads had to be built in remote corners of the world. With this latest improved model, which turns out 60 tons of mix an hour, the crew can get the plant running in a week, plus a day for calibration. The plant is made by the Barber-Greene Co., of Aurora, Ill.

Dumped into the feeder, sand and crushed stone are carried automatically to the dryer, which cooks them at temperatures up to 400° F. This drives out moisture and makes the rock ready to stick to the asphalt. A dust collector reclaims 85 percent of the fine material that is blown off by the exhaust gases of the heating unit.

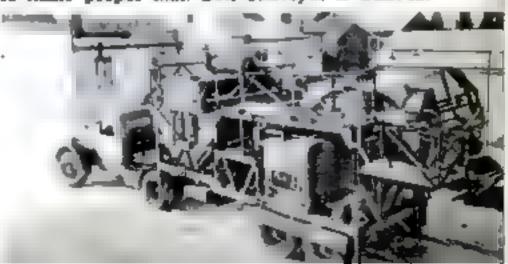
Meantime, a second elevator carries the heated stone to a bin, where screens sort out the right sizes for the kind of mix desired. Here limestone dust can be fed in for smoothness. Hot liquid asphalt is then added to the screened rocks to bind together the mix, which pours from a spout into trucks.

Aggregate dryer weight about 27,000 lb. Finned interior of long drum rotates material as it is transported through heat from high- or low-pressure oil burner. Diesel engine supplies power,

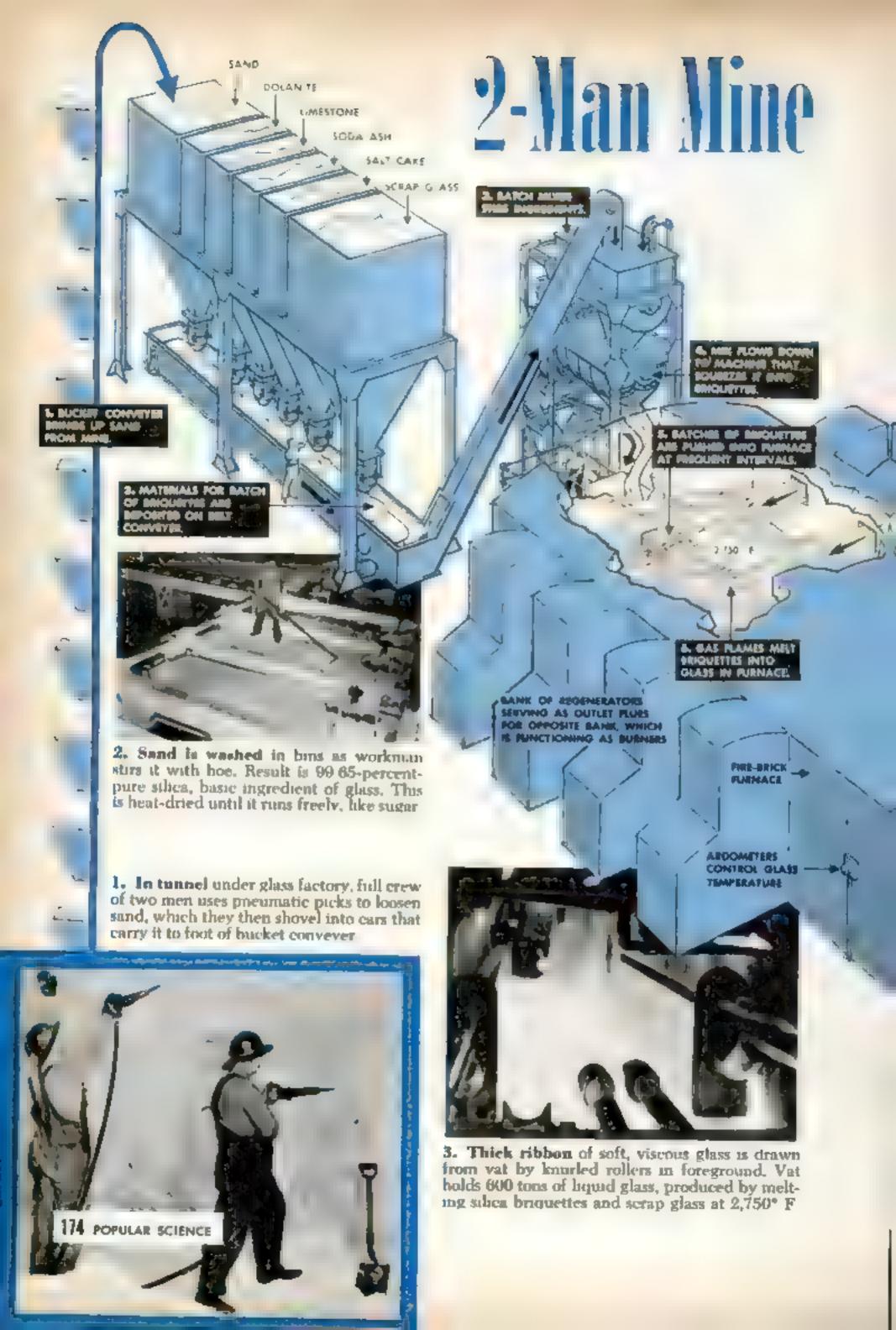


Dust collector catches dust from dryer's exhaust gases. When used with high-pressure burner on dryer, no blower is needed, but one is hooked on for use with low-pressure burner.

Mixer-gradation unit sorts aggregate, makes sure that exact amount of the right sizes is mixed with the exact amount of liquid asphalt to make proper mix. Belt conveyer is built-in.



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Feeds Huge Glass Plant

TWO men in a sand mine, digging with pneumatic picks and hand shovels, provide all the basic raw material from which this modern glass factory, 102 feet straight above their heads, produces more than an acre of sheet glass a day.

Working only five eight-hour days a week, in fact, they dig enough snow-white silica sind to keep the plant operating around the clock on a seven-day week.

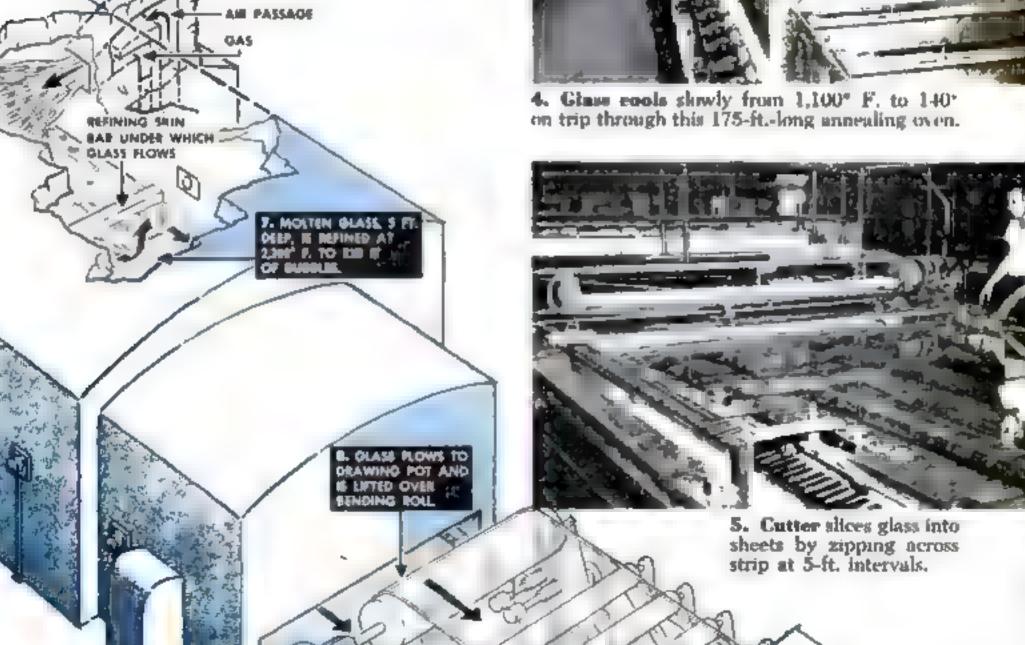
The drawing is a simplified version of the Ford Motor Co. glass mill at St. Paul, Minn. It shows how the plant converts the two

REGENERATORS SERVE AS EITHER BURNERS OF OUTLET PLVES TO SMOKESTACKS, CHANGING THEIR FUNCTION AT 20-MIN INTERVALS miners' output, brought up by bucket conveyer and mixed with other ingredients, first into briquettes and then into a continuous ribbon of glass, 104 inches wide, that rolls out of a long annealing oven at the rate of more than a mile a day



A LEAVING BENBING ; ROLL, 101-IN.-WIDE STRIP OF BLASS PASSIE INTO ANNEAUNG OVEN

APRIL, 1949 173



Gus Runs into Twin Trouble



In the Spring a young man's from how with an element of histories

aniera blonde and a balky angine can complicate matters.

TOPULAR SCHENCE



By Martin Bunn

HEY, BOSS!" Stan Hicks shouted as he bounced into the Model Garage. "It's here."

Gus Wilson pulled his head from under the bood of a sedan. "Now what?" he asked.

"My new car," Stan beamed. "It's right outside the door. Ready for me to drive."

"That's fine," said Gus. He pointed to the sedan he'd been working on. "Now these cylinders . . ."

"And just in time, too," Stan cut in. "I'm taking Spick to the city tonight for a movie."

"Spick?" Gus asked, "Who's Spick?"

"Spick Smith—her name's Mary but everybody calls her and Susan—that's her sister— Spick and Span,"

"Oh, those twins," Gus remembered. "I

can't ever tell 'em apart."

"I can," Stan boasted. "And how."

"Okay," said Gus. "Now these cylinders..."

"Spick's a good-natured gal," Stan went on. "But Span—that's Susan—is always throwing a rod about something. She's scrappy."

Gus began again. "Now these cylinders..."

"That reminds me," said Stan. "I guess the dealer must have sold my old bus for what I asked. It's a good thing you helped me with that overhaul we gave it." Stan couldn't curb his excitement over the new car.

"Yeah, I guess so," said Gus, "but these

cylinders . . .

Stan looked hurt. "Gee, don't you want to

look at my new car?"

"Oh, sure," Gus grinned. "I was just going to suggest that." They walked out of the shop to a gleaming convertible.

"Snappy, hey?" said Stan.

"Looks swell, Stan," Gus told him. "You'll be a real hot shot, driving that."

Enter Two Blondes

Gus and Stan looked up as a horn marled and a pre-war sedan was braked to an abrupt stop beside the convertible. Out of the front seat hopped two girls. Both were strawberry blondes. They looked exactly alike and they were dressed exactly alike. But there the sameness ended. One smiled sweetly at Stan. The other glared at him.

"Why, Spick," Stan stammered, "what're

you doing in my old car?"

Just then there was a wheeze and a roar

from the sedan's rear seat as a man pulled himself out the door. He was middle-aged,

stout, pompous, and obviously angry.

"This is an outrage," he thundered. "A dastardly outrage. If I do not obtain satisfaction—complete satisfaction—here and now, I shall take steps. Drastic steps. I shall file a complaint in the proper quarter and I shall press that complaint to a conclusion—a bitter conclusion for the man who has taken advantage of the innocence and trust of an inexperienced young girl."

Gus shot Stan a quick look. "Hey," he

whispered, "what you been up to?"

"I ain't been up to anything," Stan yelped. The girl who had been smiling began to giggle. The one who had been glaring turned the glare up a couple of notches. The man sputtered. Gus looked puzzled.

Mr. Smith Sounds Off

"What - what's the matter, Mr. Smith?"

Stan asked weakly.

"Matter! You know full well what's the matter," Smith roared. "I want a definite answer. No evasion. Yes or no." He jabbed a trembling forefinger at Stan's old sedan. "Were you or were you not the owner of this—this wreck?" he demanded.

"What do you mean—wreck?" Stan bristled.
"That's a good car—for its age. Yes, I did own
it, I told Sniffen and Company to sell it for me
so I could buy a new one from them. What's

wrong with that?"

"Ha!" Smith almost screamed. "So you admit it. Now did you or did you not tell Smiffen and Company that the car had been thoroughly overhauled at the Model Garage and that it was in first-class operating condition. Yes or no?"

"Of course I told them that," Stan snapped.

"And it was true, too."

"True?" Smith howled. "My daughter — poor, deluded girl—trusted you. And it was on the assurance of the salesman that you had placed the car in perfect condition that she purchased it."

"Well, it was true," Stan repeated.

"Perfect mechanical condition," Smith sneered. "Listen." He clambered into the car and pressed the starter button.

The starter ground for some moments and when the engine finally caught it ran so

roughly that it shook the car.

"Perfect mechanical condition," Smith continued to snarl. "The engine won't start half the time and if it does it sputters and bucks. And that isn't the worst of it." He turned the

switch, chmbed out of the car, and slammed up the hood. "Look," he pointed dramatically.

Stan and Gus looked. The firewall was sticky with oil and a grimy film of it seemed to coat the entire engine compartment.

"Oil-oil all over everything," Smith rumbled, "And the waste of money. It eats up

two quarts in a hundred miles."

Papa Smith seemed about to run down. Apparently the blonde with the double-duty glare thought so because she took over.

"All I've got to say," she snapped, " is that I don't think much of people who go around selling other people beat-up old autos."

"Aw, now listen," Stan began.

"You're always talking about what a great mechanic you are," she went on, "but when this car went bad on you the only thing you could think of doing was to stick somebody else with it so they'd have all the trouble and, furthermore, I don't ever want to have anything more to do with you...you..."

"Amazing," said Gus, "all in one breath."
The girl threw him a sharp look and acted

as if she were about to take off again.

"But, listen," Stan said and then broke off with a shrug. "What's the use? You never listen to anything because you always want to do all the talking." He turned to Gus. "What happened? You know there wasn't anything wrong with it when I took it to Sniffen's."

"That's right," Gus agreed. "It was in good

condition—a good buy at the price."

Gus Sounds Off

"Ha!" There was a note of triumph in Smith's voice. "So the Model Garage admits

its responsibility."

"The Model Garage isn't admitting anything," Gus told him. "We're not in the used-car business. That's why I asked Stan to have Sniffen sell the car for him instead of selling it himself. The Model Garage has no responsibility in this deal."

"We'll see about that," Smith put in.

"But," Gus said, "I helped Stan put the car in first-class condition before he offered it for sale. There wasn't anything wrong with it when it went out of this shop and there's nothing wrong with it now."

Smith held his head with one hand, pointed to the old car with the other, and whispered

hoarsely: "Nothing wrong, he says."

"That's what I said," Gus laughed. "Drive the car in the shop, Stan." The Smiths started to follow, but Gus stopped them. "If you'll come back in fifteen minutes, I'll have the car ready for you. There'll be no charge."



Stan watched him take something from a coverall pocket and quickly slip it under the hood.

"I'll stay right here," Smith shook his head, "and see what you do. Make sure there's no monkey business this time."

"I'm running this shop," Gus said, "and I don't allow visitors during working hours. You can wait in the office if you like. If you don't want to—well, I've other things to do."

"Let's wait," said the twin who had been smiling. "I'm sure Mr. Wilson will make good his promise." Her father grumbled but he and the other twin followed her into the office.

"I got rid of them to save your face," Gus grinned at Stan as the office door closed.

"Huh?" Stan started to object.

Gus Pulls a Fast Switch

"Step on it," Gus said. "Wipe the oil off all the wires and spark plugs and off the distributor and rotor. Clean out the distributor. Then slip in a new set of points. Watch the clearance."

As Stan finished the cleaning job, Gus came over to the car. Stan saw him take something from a coverall pocket and slip it quickly under the hood.

"What're you putting in there?" Stan asked.
"Never mind that now," Gus said. "Call
your girl friends and their pa."

Gus looked at the twins with a puzzled frown as the Smiths paraded into the shop.

"Who bought Stan's car?" he asked.

"I did," said the one who had glared.
"Okay," Gus said. "Start it, please."

When she pressed the starter button, the engine took hold instantly and ran smoothly.

"That's better," she admitted, "but what about oil? I don't want to be buying a quart every few miles."

"You probably won't need oil for eight hundred or a thousand miles," Gus said.

"I'm taking a friend to the city tought. I'll see how it works then . . . Come on, papa."

Smith got into the car. Stan held the door for the other twin.

"I'll stop by at seven," he said. She looked at him. "Well, you're going to the movies with me, aren't you?" he asked.

She smiled. "Seven, then."

Stan turned to Gus as the car rolled out of the shop. "What's the score? What'd you put under the hood to stop that oil leak?"

"Know what this is?" Gus asked. He held

out a cadmium-plated cap.

There Are Cape and Cape

"Sure," said Stan. "It's an oil-filler cap. Where'd it come from?"

"I just took it off your old car. Remember you mislaid the original cap when we worked on the car? Said you'd find it and put it on before driving to Smiffen's? Did you?"

"Gosh, I forgot all about it." Stan's face

reddened.

"Apparently Sniffen's men put this one on," Gus said, "and it's the wrong cap for that model. Your car takes a combined filler cap and engine-breather cap. The engine couldn't breathe with this one. It didn't permit any crankcase ventilation. All that oil vapor was forced out around the rear main bearing and under the valve-cover plates."

"Cosh," was all Stan could mumble.

"The vapor even forced its way up the distributor-shaft bushing and fouled the distributor points almost enough to put the engine out of action. I found the cap you mislaid and as soon as I looked at that engine I knew what was wrong. You've been thinking too much about that pair of blondes," Gus joked.

"Only about one of 'em," Stan said.

"Which one?" Gus asked. "I still can't tell 'em apart."

"The nice one," Stan said. "Spick. Not the

one that bought the car. That's Span."

That evening Gus was in the city. He was paying a parking-lot attendant when Stan drove up in his new convertible. A twin sat very close beside him.

"Hello," said Gus. "Hello, Miss Spick-like

the show?"

"It was wonderful, Mr. Wilson," the girl smiled, "but I'm not Spick. That's Mary. I'm Span-Susan."

"Oh," said Gus. "But I thought Stan said—never mind. I can't tell you two apart."

"I can-now," Stan said, "but this afternoon I thought that Span was Spick and that Spick was-well, boss, you see how it is?"

"No, I don't," Gus grinned, "but anyway, it's your problem, not mine."

How Overdrive Works

Here are some little-known facts you'll find valuable if your car is equipped with this semi-automatic transmission.

Drawings by Stewart Rouse

WHEN you first take the wheel of a latemodel car equipped with overdrive, you'll soon discover that some of your old driving habits don't quite fit. For one thing, you are used to judging car speed by engine sound. So you may scare yourself on the first curve. Or collect a few speeding tickets.

There's a reasonable explanation for this. Overdrive cuts engine speed 30 percent. Compared to the job it usually has to do, the engine loafs. Naturally, it runs more quietly, and you're apt to underestimate the speed at

which you're traveling.

Automatic overdrive was introduced 15 years ago. Since then, two and a quarter million units have been manufactured and installed on cars. Yet, despite its long history and expanding use, there's surprisingly little understanding of how it works or what you can do with it. Many drivers think of it solely as a fourth gear for open-road cruising. But that's just part of it.

Reduction of engine speed is the basic idea behind all overdrive equipment. From this, you get two direct benefits—better gasoline mileage and longer engine life. In addition, you have two extra forward speeds

and many of the conveniences of an automatic transmission.

Gasoline is saved because of reduction in the total horsepower required to propel the car. Tests with a stock car have shown why.

It was determined that 12 hp. was needed simply to move the car at 40 m.p.h., either in conventional high or overdrive. However, engine friction and power losses in driving engine accessories demanded an additional 18 hp. while the car was in conventional drive. In overdrive, since the engine speed is reduced, this figure was cut to 11 hp.—a sav-

ing of 7 ho

Except for a new type recently announced for dealer installation on Chevrolets, all over-drive units now in production for current-model cars are made by the Warner Gear Division of Borg-Warner Corporation. In the Warner units, there are slight variations in the electrical circuits and external housings from car to car, but essential components are virtually the same. The accompanying drawings show the working principles of a typical late-model unit. For clarity, some parts are exaggerated.

A modern overdrive unit is a supplementary two-speed transmission. It's mounted directly behind the normal three-speed trans-

DID YOU KNOW?

 Overdrive adds two extra speeds to your three-speed transmission—overdrive second and

overdrive high.

Overdrive second permits you to drive in traffic without touching clutch or shift lever. After engaging second, you can shift back and forth between second and overdrive second simply by manipulating the gas pedal.

 Below cut-in speed, after the car's once in low, you can shift at will without the clutch. In

shifting up, release gas pedal briefly.

 You can engage overdrive (push in control knob) at any speed.

 You can lock it out (pull out control knob) at any speed. Before pulling the knob, kick down the gas pedal.

A FEW CAUTIONS

 Always lock out overdrive on slippery roads or when descending a long hill.

 Don't try to lock up into conventional drive below the cut-out speed without first feeding a little gas. You won't cause barm, but the unit will make an alarming buzz.

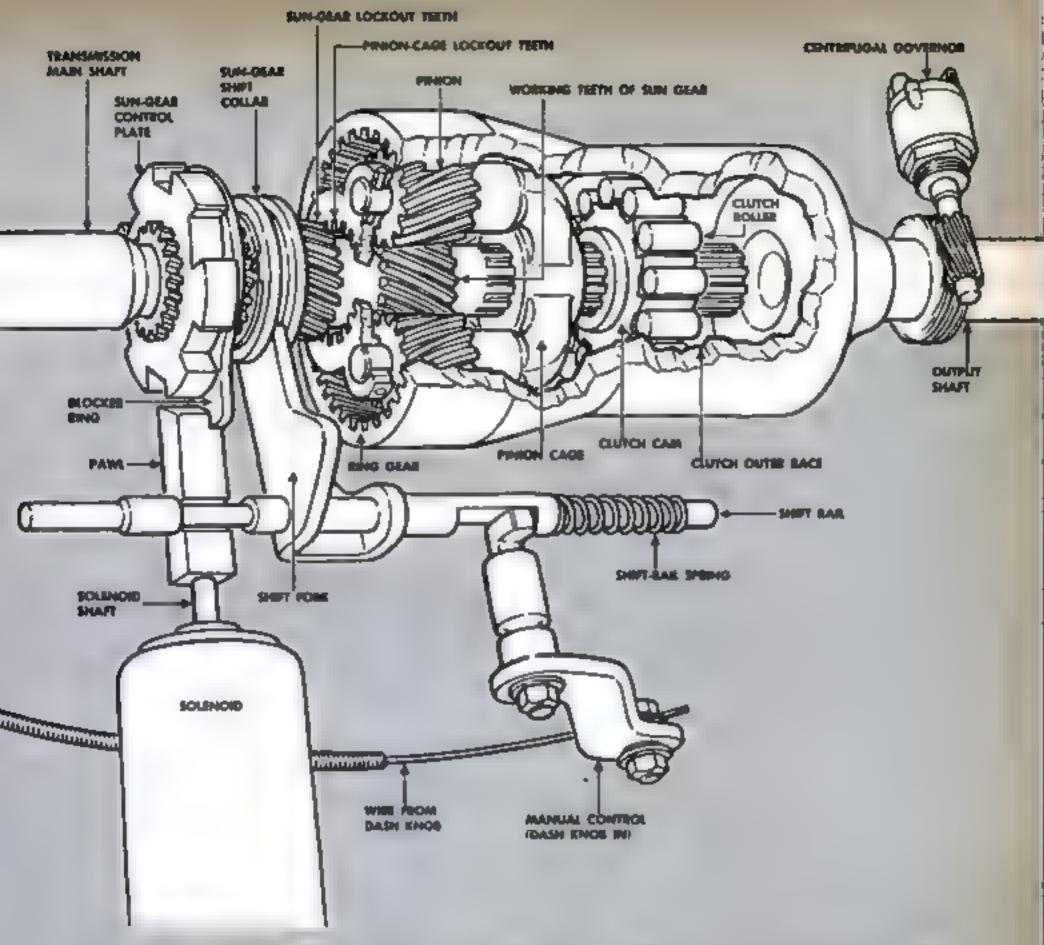
 Don't try to lock up above the cut-in speed without first kicking down from overdrive. Until you do, the dash knob won't pull out.

• In overdrive second, stay below 50 m.p.h. to avoid excessive gear velocities. With older cars, don't exceed 35 or 40 in overdrive second.

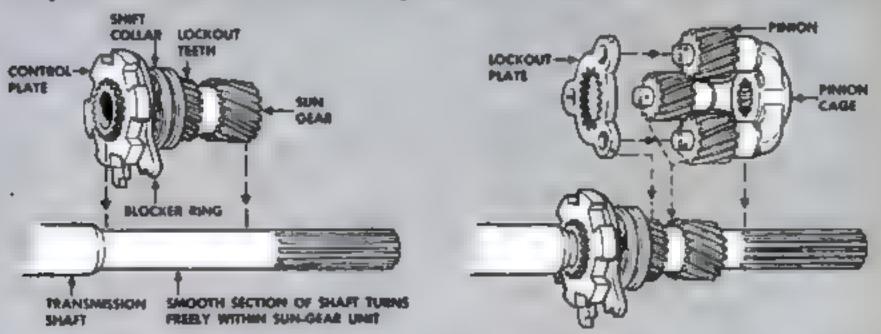
• Leave the car in reverse when parked on a

 When being pushed for a dead-battery start, lock up into conventional high.

180 POPULAR SCIENCE

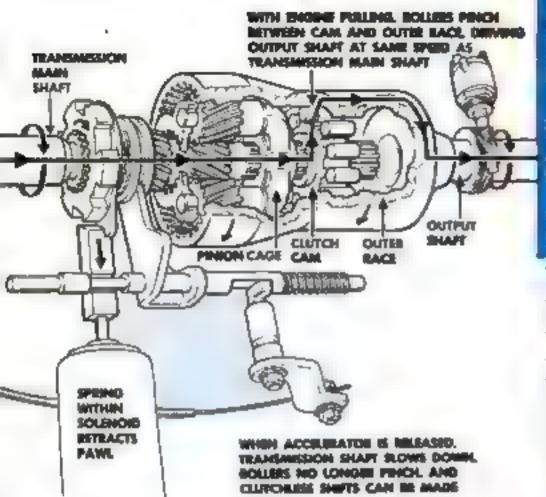


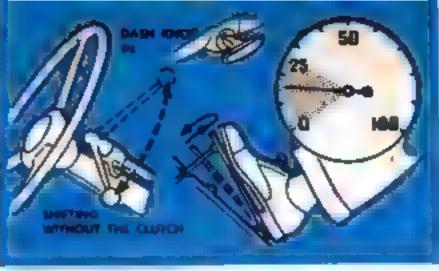
The parts of an overdrive unit are in the position above while car is at rest with dash knob in.



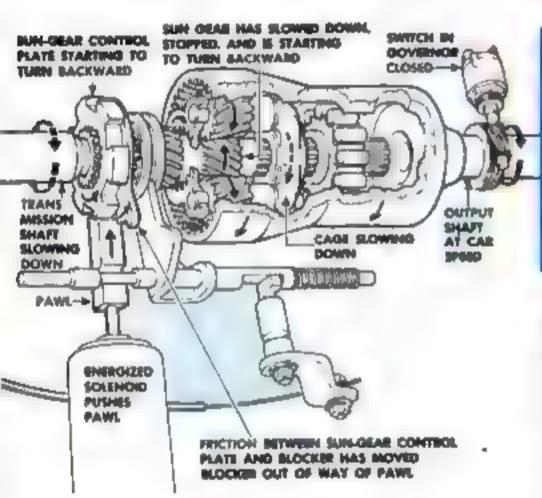
Planetary gears form the heart of overdrive. They give a ratio change that reduces engine speed in relation to car speed. The planetary set consists of a sun gear, three pinions that walk around it, and an outer ring gear. Entire sun-gear unit simply rests on smooth section of main shaft.

There's no driving connection between the two. Pinion-cage hub is splined to shaft. Hence, the pinions are constantly carried in a circular path around the shaft. The pinions transmit power only when overdrive is in use. For this, sun gear is held stationary.





Let's see how overdrive works, starting out from standstill with dash control pushed in. Up to cut-in speed (25 m.p.h. here) drive is through the freewheeling mechanism. The transmission main shaft extends through sun gear and is splined into the pinion cage and freewheeling-clutch cam. As engine drives the cam through main shaft, rollers move outward into wedging contact with outer race, causing latter to rotate and deliver power to wheels. Let up on the gas and roller clutch releases, allowing shifts without the regular clutch.



25 50

When car reaches cut-in speed, the governor energizes solenoid and latter urges the pawl toward engagement with notched sun-gear plate. While engine is driving, blocker ring balks this engagement. When you let up on the gas, car momentum tends to drive engine. Reverse torque results. In fraction of second, roller clutch disengages, sun gear and plate slow, stop, and make slight backward turn. By means of friction, control plate carries horseshoe-shaped blocker ring backward too. This frees the pawl, allowing it to engage notched plate.

mission. Thus you have a total of five forward speeds.

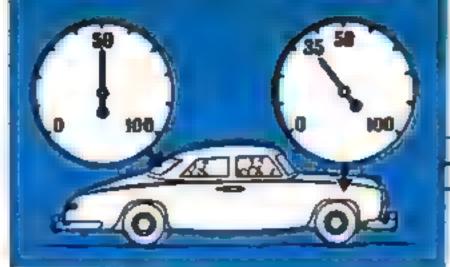
In order of gear ratio, these are low, second, overdrive second, high, and overdrive high. There's only a little ratio difference between overdrive second and high, but overdrive second is nevertheless a convenience that some owners don't know they possess—an automatic gear for easier traffic driving.

This is particularly true in the largerengined cars with overdrive units set to cut in at relatively low speed. With such a car, you can do all your traffic driving in second and overdrive second—without touching the clutch or shift lever. Second provides all the power you need; overdrive second gives you the speed.

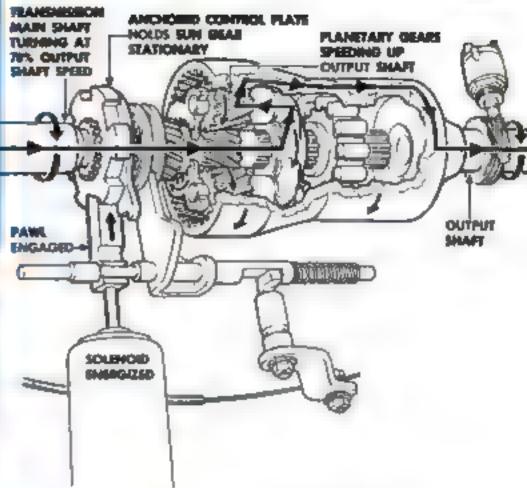
The things you do to operate overdrive are few and simple. To place the mechanism in readiness for automatic operation, you push in the dash knob. You can do this while the car is at rest—or at any speed.

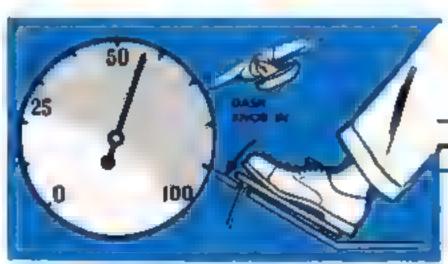
Starting from a standstill with the knob in, you shift into low in the usual way. From then on, until you reach the overdrive cut-in speed, you can shift into or out of any conventional gear without touching the clutch.

In shifting up, just release the accelerator momentarily while you change the gear lever. In shifting down, simply move the lever. A downshift from second to low is best done



Now you're in overdrive. With pawl engaged, control plate keeps sun gear from rotating. Drive is now from main shaft to pinion cage through splines. This causes pinions to walk around the sun gear, transmitting the power to the outer ring gear, thence to the outer race, and finally to the output shaft. The engine travels only 70 percent as fast as car. This is because of the step-up in ratio provided by the planetary gears. For every revolution made by ring gear, pinion cage makes only .7 revolution on its own axis.



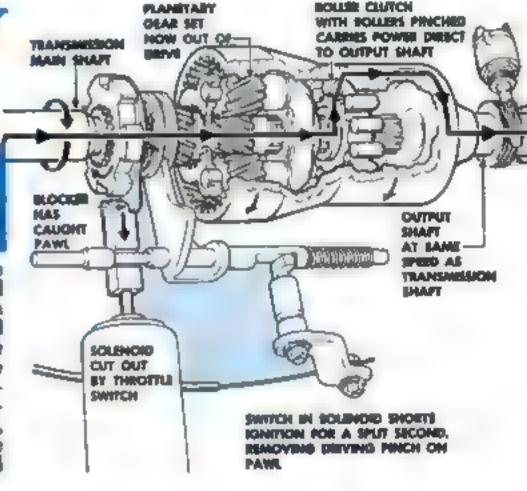


Pushing gas pedal to floor shifts overdrive down to conventional gear. When down, pedal works kickdown switch, cutting current from solenoid. A spring then tends to withdraw pawl from sun-gear plate. However, the engine torque pinches and holds pawl. To overcome this, the kickdown switch also interrupts ignition for fraction of second, slowing engine and causing reverse torque. This allows pawl to disengage, giving direct drive. When car slows below the cut-out speed, governor cuts solenoid, pawl withdraws, and freewheeling drive results.

with the clutch, however. Low is not a "synchronized" gear and you may cause clashing.

This clutchless shifting at low speeds is made possible by the freewheeling built into the overdrive unit. Each time you let up on the gas, the car freewheels. When you shift, the overrunning clutch within the unit automatically does the job of the regular clutch.

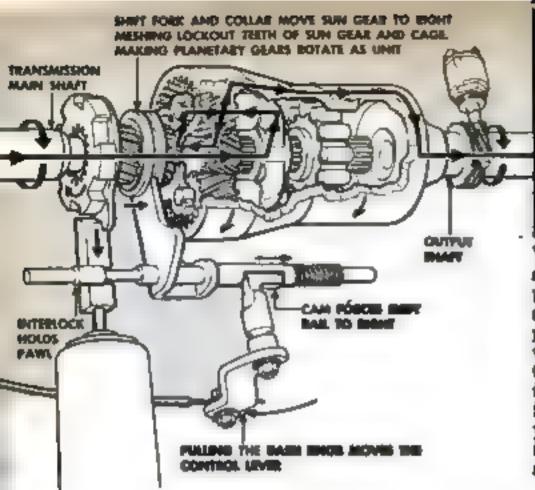
Overdrive cut-in speed is set at the factory. It varies with the make of car—somewhere between 18 and 32 m.p.h. After passing this speed, you lift your foot from the accelerator. The result is an automatic upshift into overdrive. If the regular transmission is in second, you go into overdrive second. If it's in high, you go into overdrive high.



When you need a quick burst of power, perhaps to pass another car, you simply jam the accelerator to the floor. This automatically downshifts to conventional gear.

At car speeds above the overdrive cut-in point, you must use the regular clutch to shift between conventiontional high and second gears. That's because the overrunning clutch doesn't have a chance to do the job it does below cut-in. As soon as you lift your foot from the gas pedal, the unit automatically upshifts into overdrive.

Unless you kick down to a conventional gear, the overdrive ratios continue to function until car speed drops to about 4 or 6 m.p.h. below the cut-in speed. At this point,



You can lack out everdrive while car is moving simply by kicking down accelerator and then pulling out dash knob. Pulling the knob moves shift sail and shift fork, bringing sen goer into position so that the teeth at right of shift collar will engage the corresponding internal teeth in the pieies enga. This makes entire group of internal working parts turn as a unit, eliminating internal working parts turn as a unit, eliminating freewheeling and evertrive. Before pulling knob, you must press gas pedal to kick down everdrive if engaged and cause meshing goes to turn at teste speed.

the car automatically reverts to conventional gear, either second or high, when the governor cuts power from the solenoid.

You can lock out overdrive entirely at any speed. Just push down the accelerator momentarily and pull out the knob. It can be done so quickly that you get almost no acceleration—a point to remember if you are descending a hill and need to lock out to get engine braking.

Overdrive has passed through a series of engineering changes since its introduction in 1934. Early types were controlled by a speed-sensitive automatic clutch that required a driver to slow down to cut-out speed to reengage conventional drive. In 1939, an electric kickdown switch permitted shifting back to conventional drive above engagement speed.

In the latest overdrive, the governor and solenoid are the principal electric controls. The governor is operated by the car drive shaft. When the car reaches the cut-in speed, with the control knob in, the governor switch closes, sending current to the solenoid. Energized, the solenoid tends to push the engagement pawl toward the notched control ring attached to the sun gear. However, the blocker ring stops and holds the pawl.

This horseshoe-shaped ring rides on the hub of the control plate. Friction causes it to respond to movement of the control plate, through a small are in either direction, until arrested by stops.

The sun gear and control plate are a single, splined unit that surrounds the transmission main shaft. This point is essential to understanding how overdrive works. Until an over-drive ratio is engaged, the sun gear merely

idles. While the ratio is engaged, the sun gear is held stationary.

When you let up on the accelerator momentarily, the engine slows but the momentum of the car tends to drive it. The power flow is reversed. Torque reversal occurs.

In a fraction of a second, the sun gear and its control plate slow, stop, and then twist backward slightly. Friction carries the blocker ring along. Allowed to slip off the step of the ring, the pawl thrusts inward, engaging the notched collar and locking the sun gear.

When you kick down from overdrive to conventional gear, the notched control plate must be released by withdrawing the pawl. Engine torque, however, binds and holds the pawl. When you push the pedal to the floor, a switch opens the solenoid circuit. It also closes contacts that temporarily interrupt the ignition.

Interruption of the engine torque allows the pawl to be snapped out by a strong spring, whereupon the ignition and engine torque are restored. The entire sequence happens so fast that only a few explosions are missed.

Upon release of the pawl, the engine speeds up. When its speed reaches the value corresponding to direct drive, the roller clutch engages and you operate in conventional gear. This continues until the driver no longer needs full power and lets up on the pedal. As he does, overdrive again engages.

What about reverse? That's taken care of, too. Since the roller clutch will not drive the car backward, the transmission reverse-shift mechanism automatically locks out over-drive. There's no need to touch the control button.

New Torque Converter Drives Bus

EVER feel the surge of power as a modern bus pulls away from the curb? There's no jerking, no gear changing. A hydraulic

torque converter does the trick.

Some buses have been fitted with this type of no-shift transmission for as long as ten years. Buick introduced it to passenger cars last year (PS, Feb. '48, p. 113). Now General Motors is announcing an improved type for bus use.

Passengers will notice little difference between the new and old-but repairmen will It's less bulky, 300 lb, lighter, and readily

accessible for servicing

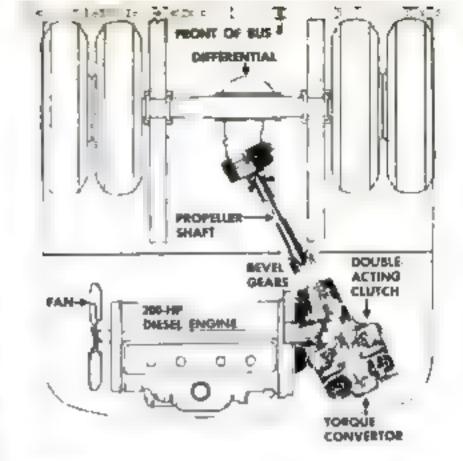
Attached to the rear end of the transmission assembly, a torque converter of new design delivers power from the same side that it receives it. In older type, power

flows straight through the unit.

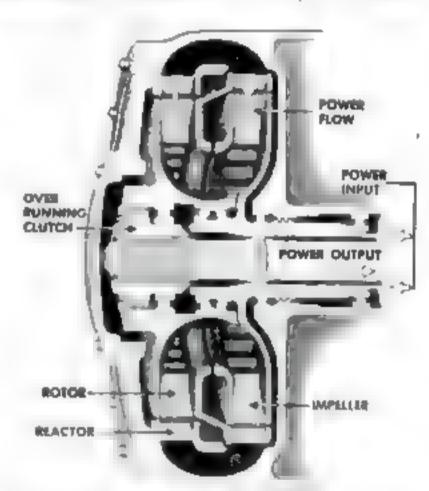
The transmission assembly includes two major parts-the converter and a doubleacting clutch. The engine drives the clutch. At low speeds, the clutch shunts engine power to the converter, and the latter increases the torque delivered to the drive shaft-just as low and second gears do in an ordinary transmission. When the bus reaches a certain speed, the double-acting clutch automatically gives direct drive. At this stage, the rear end of the drive shaft merely idles in the overruning clutch within the converter.

Pressurized oil fills the converter casing at all times. The impeller and rotor revolve: the reactor is stationary.

Large buses ordered for Chicago and New York



Hydraulic transmission just introduced by GM sits at angle to engine, located across rear of bus. Bevel gears carry engine power to the transmission. Converter is easily removable.



Converter employs new principle. Power flow comes out same side it goes in, instead of passmg straight through. Converter's job is to multiply torque delivered to drive shaft.

one-unit buses ever built, these conches sent City are first to use new transmission. Longest 50 to 55 passengers and stand many more,





Engine Converts Trailer to Home on Wheels

MOBILE and compact, the rolling home pictured above is a standard trailer powered by a Mercury V-8 engine. The trailer body was reversed, front to back, and mounted on a specially built chassis. Windshield, instrument panel, and controls were installed bus

fashion while the engine, with twin radiators and fans, was mounted in the rear. The vehicle weighs 7,200 lb., goes 10 nules per gallon, is 25' long, and has a 13' wheelbase. It sleeps two and has all conveniences,—John F. Wilson, Toronto, Out.



Special Mitt Washes Autos

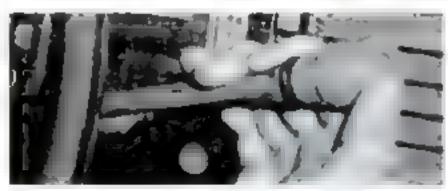
STICK a couple of the pellets in the Magic Bubble Mitte, put on the mitt, dip it in water, and you're ready to wash your car. When finished, ruse the car with a hose This, according to the Pit-Bar Manufacturing Co., Los Angeles, leaves the car shining without wiping. The mitt, made of lamb's wool, and 12 pellets are priced at \$1.20. plastic is rustproof, stainproof, and flexible.



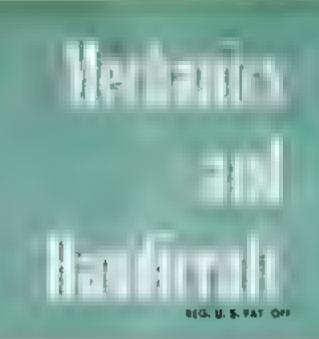
New Nash Has Plastic Screens

Made of Lumited, the plastic screens on the 1949 Nash are installed by slipping them over the tops of the doors. An elastic insert in the bottom edge insures a snug fit. Seats in the Nash can be converted to twin beds for overnight stops. The screens were developed to protect sleepers from insects. The

Gearshift Coin Clip Holds \$2 in Change



HELD to the gearshift lever by a rubber adapter, this plastic coin clip takes any coin from a cent to a quarter. It holds about \$2 in change right at your finger tips for parking meters, toll bridges, and other petty expenses. Distributed by Rosenberg Brothers, New York City, it's priced at about 50 cents,



Rotary Mower Cuts Lawns

Modeling a Narrow-Gauge Loco
PAGE 188

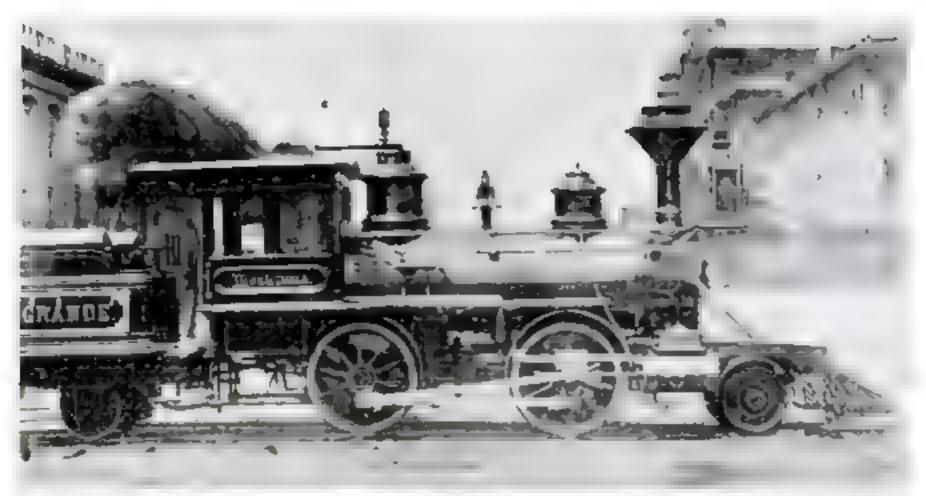
How to Fix Zippers

Television Set from a Kit

PAGE 226

Edge-Molding with Power Tools
PAGE 234





Built by the Buldwin Locomotive Works in 1871, the Montezuma had steam jets on the front

of the cylinders to scare cattle. Because of its 3' gauge, it was shipped to Denver on flat car

Old Narrow-Gauge Engine Modeled in 110 Scale

By George Walton

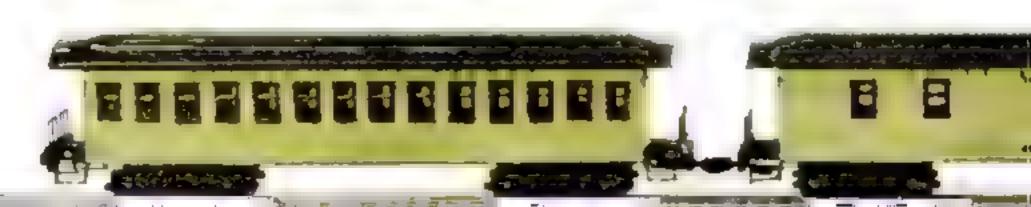
A HANDSOME old-timer to model for your HO layout is the Baldwin-built Montezuma, No. 1 locomotive of the then narrow-gauge Denver and Rio Grande Radroad

The Montezuma ran on a 3' track, and the model pictured here was scaled 7'32" to 1'. This is larger than HO scale, but enables the engine to run on regular HO track. With old-style coaches coupled behind, the colorful 2-4-0 is a thrilling picture on any pike Scale speed is well over 100 m.p.h.

Only the motor, gears, and wheels were purchased. These came to about 39. The motor, a 12-volt DC job, is coupled through a worm-gear drive of 29-to-1 reduction. The frame was cut away in the rear to receive the motor. Two upright clips soldered to the frame in front of the motor were bent over to anchor its front end. The rear end is bolted to a plate soldered into the frame You'll have to adapt the mounting method to suit your motor.

Out and file the frame from %" by %" brass channel. Notch the frame for the axles To get the inner end of the notches rounded,

Oldtime, open-platform coaches for the Montezuma are painted a colorful yellow and green.





drill a hole there and then saw to it. At this time also make any adjustments in the motor position so the worm gear meshes properly with the gear between the front pair of drivers. To reduce side play of the drivers. slit small washers and solder them to the

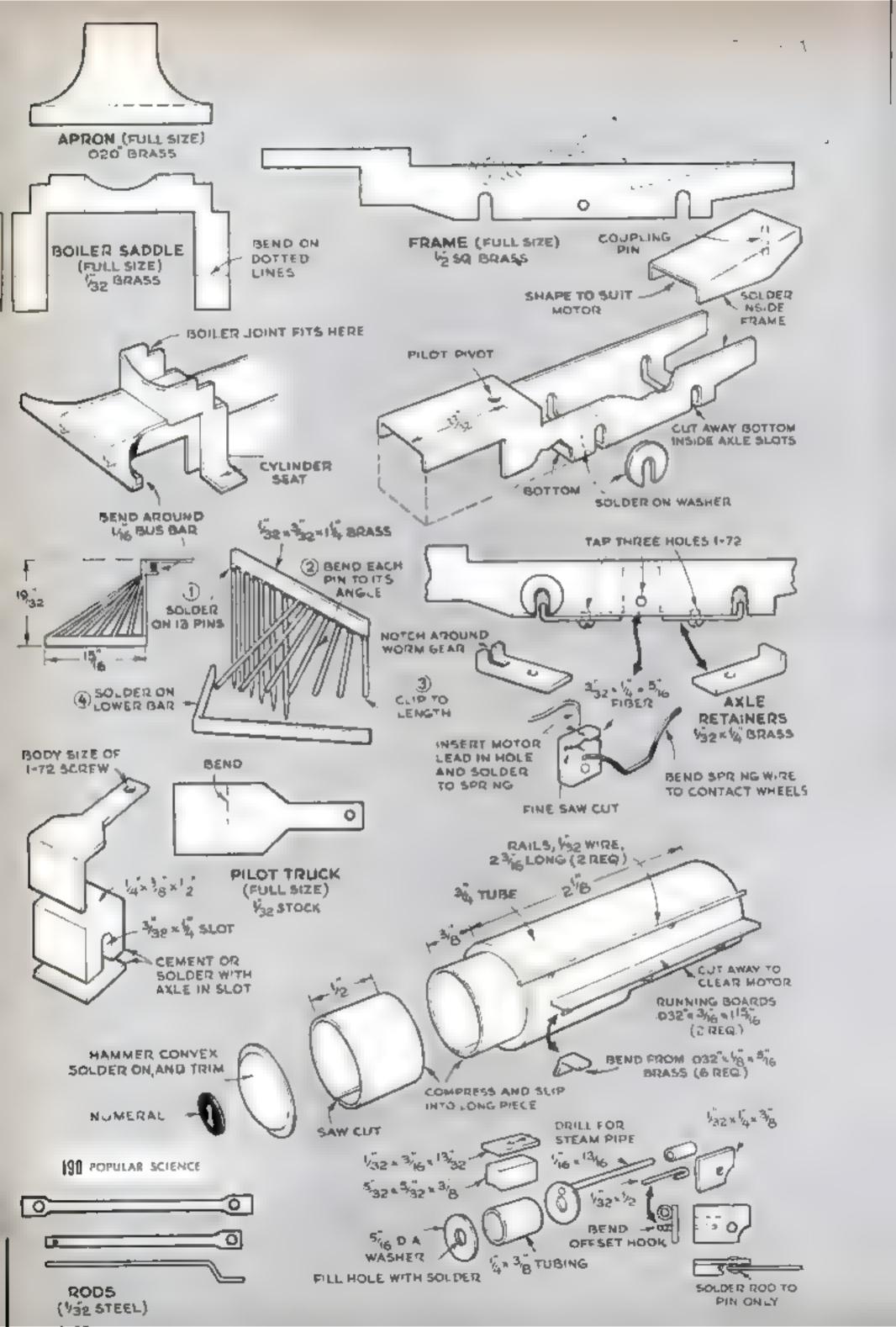
frame around the axle slots.

Form the apron of ,020" brass and punch it around the edge to simulate rivets. Solder it to the front of the frame. Next cut the boiler saddle of .032" brass, bend it as indicated, and solder it in place. This forms a cradle for the boiler front. The assembled cylinders also are soldered to the cradle.

A row of ordinary straight pins and two brass strips, one bent, form the cowcatcher, Lock the pins in a vise to solder them to the top strip. Then bend them to their correct angles, cut them off, and solder to the other strip. Solder the top strip to the apron.

Short lengths of K" copper tubing form the cylinders. Solder small washers to each end. Fill the hole in the forward washer with solder. Use a piece of brass, lead, or type metal for the valve chests. File them to shape and solder on top of the cylinders. Add the top plate, drilled for the steam pipe. Then solder the entire cylinder assembly to





the two horizontal lugs on the boiler saddle.

Drill and tap the frame for the screw to hold the piece of fiber that fits between the drivers. Slot the fiber to take a short piece of thin brass wire that will be bent to exert gentle pressure on both drivers. This is the current pickup for the insulated drivers. The axle retainers are two small pieces of brass bent and screwed to the bottom of the frame. Notch the forward one to fit around the worm gear.

For the pilot, buy a pair of 7/16" insulated or plastic wheels mounted on an HO axle. Lay out the metal part of the truck and bend it as indicated. Notch the %" by %" by %" plastic block and cement it in the bend of the metal. After putting in the axle, cement a thin piece of plastic over the bottom of the slot. The rear of the truck is attached to the frame by a pivot screw. If you prefer, the notched block can be of metal, and the whole job soldered up.

Two pieces of %" brass tubing make up the boiler. Slit the %" length, compress it, and telescope it into the longer length. Hold it with solder. A circle of .020" or thinner brass forms the boiler front. Cut it a little larger than the boiler diameter and hammer it to a rounded shape. Solder it to the boiler front with the rounded side out. Carefully trim and file it to the outline of the boiler You can make the numeral 1 for the front of the boiler by typing it on a piece of .010"

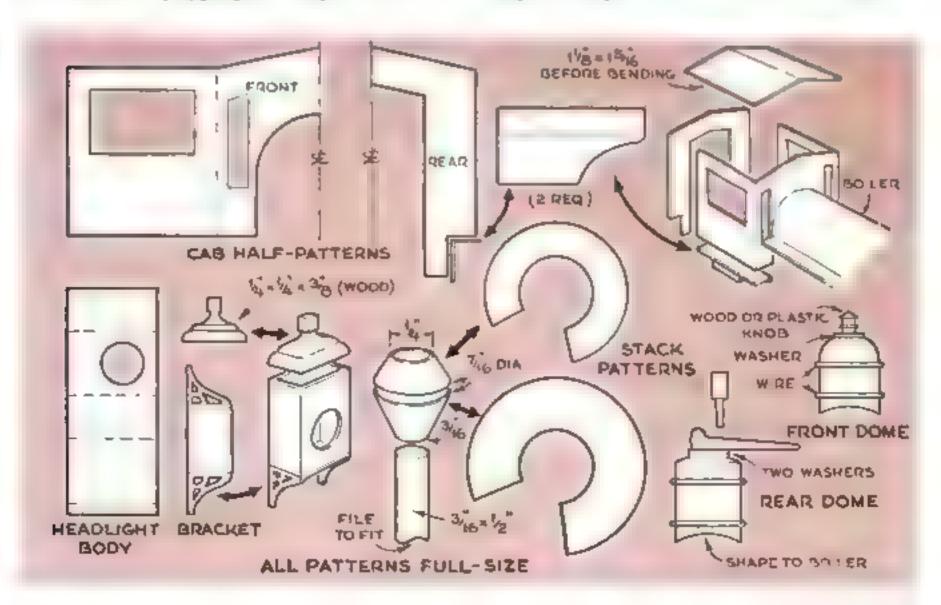
brass. Cut out a small circle containing the number and cement it to the boiler. Before assembling, a punch may be used gently to simulate rivets around the number and around the boiler front.

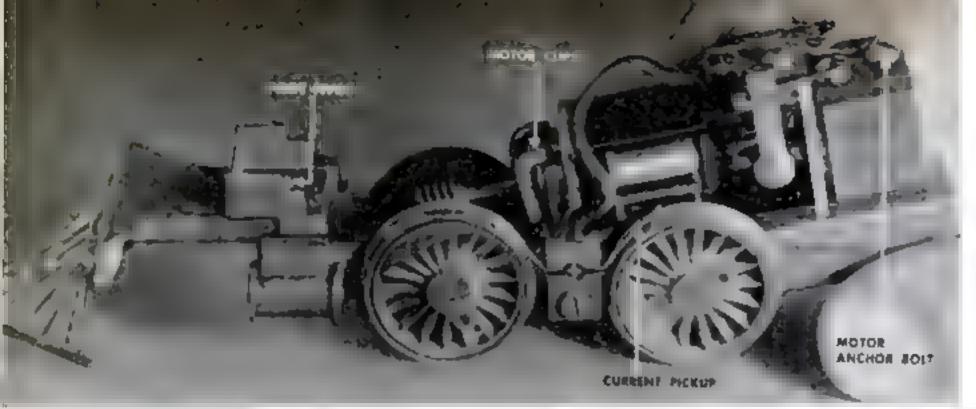
Depending on the motor you use, it may be necessary to cut away the underpart of the boiler at the rear to clear the motor. You'll probably also have to cut a hole toward the front to clear the worm gear,

All cab patterns are shown full size. Cut them from .032" sheet brass and file the edges smooth. Start the windows by drilling and finish by filing. All parts are soldered together, the roof going on last, Solder the assembled cab to the rear of the boiler.

Stack, headlight, and headlight bracket are cut from .010" brass. Roll up the pieces that form the stack to the given diameters. Then snip the excess off one end and solder. Easiest way to make the headlight top is to carve it of wood or plastic. If you wish, fit a midget bulb in the lamp before final assembly. Use a bulb of the same voltage as the motor. A small burr in a hand grinder will help cut out the scrollwork on the lamp bracket. You can, instead, simulate it when you paint the model.

Make up the domes from dowels or copper tubing to which caps of brass sheet have been soldered. The rings encircling the domes can be bus bar or wire that's soldered or glued in place. For a whistle, I used the

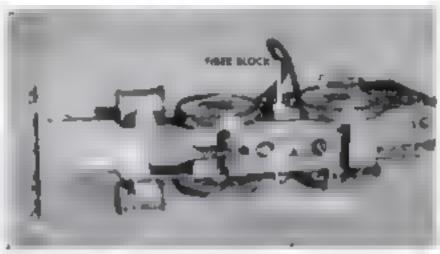




Here the motor and drivers have been mounted. Note bent bus bars that anchor the motor.



At left above is bottom view of assembled boder and cab. Screw in front and solder at rear hold



at to frame. At right is bottom view of the assembled 12-volt DC motor and the frame.

uncoupling pin of an HO automatic coupler. You can turn one, if you don't have a lathe, by holding a file against a bit of brass rotated in a drill chuck. The bell may be bought or shaped from plastic or wood. To support the handrails, drill holes in the boiler and pass pms through. Solder the pms inside the boiler. Make the rails of stiff wire

I fastened the completed boiler and cab assembly to the chassis by one screw below the front of the boiler and by soldering to the frame at two points beneath the cab with bits of brass sandwiched between, Two 1/16" struts are soldered to boiler and apron.

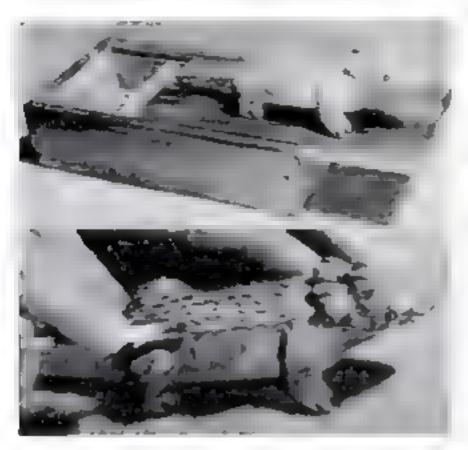
Strict scale requirements call for 40" spoke drivers, which should measure \$", and can be bought in that diameter for HO gauge, mounted on axles. However, I used slightly larger drivers to give the engine a greater scale speed for the gear set I had. One wheel of each pair is insulated. These go on the left side of the engine. Bend the spring wire to exert gentle pressure against the tires of the insulated wheels, but not so much that it will bind on the drivers. To insure good grounding of the uninsulated wheels, solder two pieces of wire to the frame on the right side of the engine. Bend these

pieces so as to contact the uninsulated tires.

Before mounting the drivers, thread them with a 1-72 or 0-80 tap for the screws to hold the side rods. Cut and file the side and drive rods from 1/32" steel and drill them for the screws. These holes must be exactly the same distance apart as the axle centers. You can simplify the job by drilling the holes slightly farther apart and then bringing them to the correct distance by bending the rods. Correct spacing of the drive rods to bring them in line with the cylinder centers can be accomplished by using small beads or tiny washers cut from plastic tubing and by bending an offset.

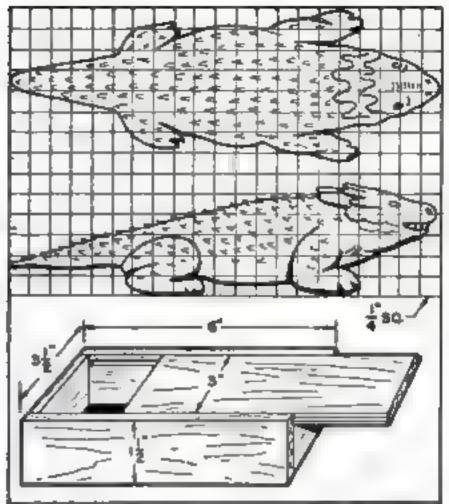
There are a couple of ways you can prevent the screws holding the drivers from backing out when the engine is run. Incompletely thread the holes so the screws will bind, or spot a bit of solder on the end of the screws after they're in place. The simplified crosshead is a bit of tubing that slides on the guide with a rectangle of brass soldered to it. The drive rod is soldered to the shank of an escutcheon pin free to pivot in the crosshead. A following issue will cover building the tender and cars and painting the train.

Carved Horned Toad Decorates Desk Box



An interesting carving project, the engaging little monster pictured above decorates the box and also serves as the lid handle. Carve it of fir, poplar, or some other wood that doesn't split easily.

First lay out the figure and saw it to shape. For the present, never mind the spines; they are taken care of later. After carving the horns on the head, shape the legs and body. Then sand the carving and paint the entire piece a dull, grayish green. Ordinary water colors work well, penetrat-



ing the wood to a shallow depth. Give the mouth a row of white teeth,

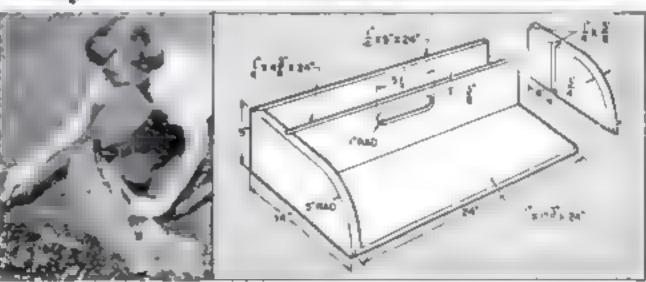
When the figure is thoroughly dry, it's ready for the spmy armor. This is done with a V-shaped carving chisel. Push the chisel point into the wood (see lower photo) and raise the chisel just enough to cause the tip of the spine to stick up. Don't raise it high enough to break the wood. Put spines all over the back, legs, and sides. You'll probably find that paint penetrated under the spines.—Elma Waltner, Hurley, S. D.

Padded Tool Tray Protects Gardener's Knees

ALL your small garden implements are kept together for easy carrying in this tray, and the soft cushion protects your knees from bruises. I built the one shown here of %" and %" stock and decorated it with decals.

Cut out the ends and saw them to shape. Then cut the dadoes and rabbets as indicated in the drawing. After sawing the 4%" by 24" divider to size, lay out and drill two 2" holes. Cut out the waste between them to form the handle and sand off the sharp edges. Assemble with brads and waterproof glue. Sand and paint the tray.

Install the cushion after the finish has



dried. Tack a 14" by 30" piece of imitation leather along the divider 2" from the bottom. Fold down and tack the excess 3" at each end. Slip a 2" piece of foam rubber into the pocket formed by the tray bottom and leather. Pull the other edge of the leather under the tray and tack it. You can substitute cotton padding for the rubber.—Whitney K.: Towers, Los Angeles, Calif.



Dimensions and construction are shown in the drawing and the completed set in the photo.

Materials used were a few square feet of leather, three pieces of plywood, and the hardware.

Bay and Belt Set

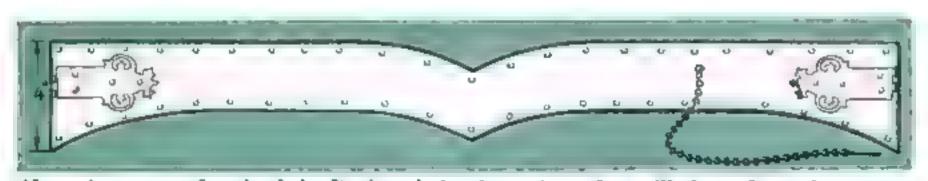
By Myles De Russy, Jr.

NEXT time you want to present a gift, save yourself several dollars with this bag and belt set. It's a handsome but simple project. The cost of the materials is small compared with the price of a similar commercially made set. I turned out this one with only hand tools in three evenings.

Chances are you already have all the tools you'll need-a hooleum kmfe, hammer, side-

cutting phers, and a leather punch. If not, the punch is probably the only extra tool you'll need to buy.

Shop carefully for the leather. I bought mine from a company that supplies shoe repairmen. A good bet is a shop that handles craftwork supplies. Such a store is more apt to sell you just the amount of leather you need rather than an entire hide. Select a good cowhide of medium weight. The back or side—not the belly—is best for a bag and



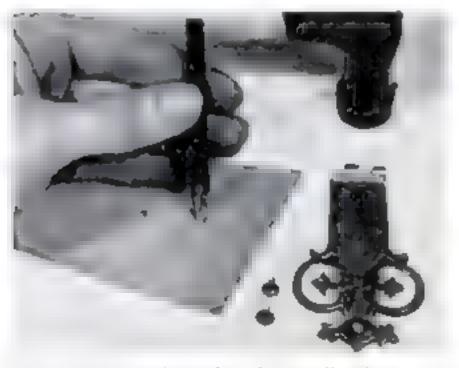
Above is pattern for the belt. No length is given since that will depend on the wearer,



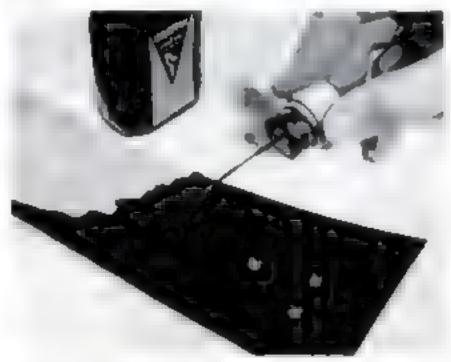
Use a straightedge to guide the knife. Pencil the pattern on the rough side of the leather.



Attach bottom, sides, back, and front to the plywood frame with brass upholstery tacks



Hinges are held in place by small split rivets. Lay out the hole locations and punch them out.



Color the leather by applying shoe dye with a dauber. Completed set is waxed and polished

Cut from Cowhide

belt set. Before buying, test the leather by bending it at one corner. If it cracks, it's not good for your purpose.

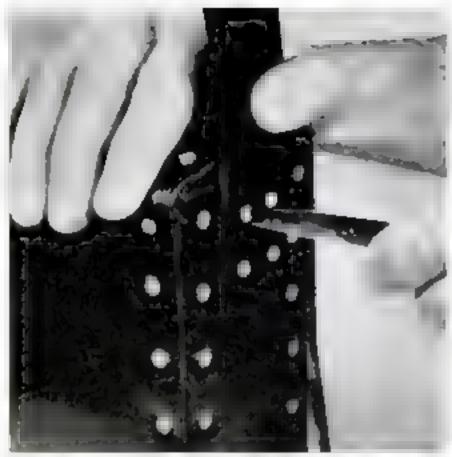
Besides the hinges, here's the hardware you'll need: upholstery tacks with decorative heads, about 20" of brass chain, two cotter pins, eight small brass wood screws, and some %" brass split rivets. You can buy the hinges at a hardware store, or perhaps find an exceptional pair at a secondhand or antique shop. Be sure that they are brass to match the other hardware. Knock out the hinge pins. The cotter pins will take their place, acting as catches on the bag and belt

The drawings give you all the dimensions except the length of the belt. That'll depend on the wearer. Lay out the patterns on paper and then transfer them to the cowhide. Use a pencil to trace the outline on the rough side of the leather.

Make the belt first. When cutting along a straight line, use a ruler. Draw the knife slowly along the edge. With a sharp knife, you'll have no trouble cutting the skin. Position the two parts of a hinge on the ends of the belt and lay out the holes for rivets. At this point, dye the leather. I applied ordinary shoe dye with a dauber

The decorative tacks on the belt are spaced about 1" apart and 4" in from the edges. Push all the tacks through. Turn the belt over and snip off the ends with the side-cutting pliers. Cut the ends off close to the leather. Then turn them down with a hammer. To complete the belt, rivet the hinge in place and attach the chain and cotter pin.

The three pieces of wood that form the frame can be cut from X" to X" plywood or hardwood. Screw them together and line the pieces with velvet or suede. Glue



Secure the ends of the shoulder strap to the sides of the bag with screws into wood frame



Fasten the hinger with split rivets. The ends of the chain on bag and belt also are riveted.

will hold the lining. Then you're ready to tack on the five pieces of leather. First, however, clamp the front and back pieces in place and mark the locations for the hinge holes. Punch these holes before tacking on the leather. Tack on the sides and bottom, overlapping the edges with front and back.

Cutting the shoulder strap is easy, Use two pieces of leather each about 2' long. Suit yourself about the width, Dye them and attach a brass buckle to an end of one strap and punch holes in an end of the other strap to suit the buckle, Fasten the ends of the strap to the sides with brass wood screws. Use screws long enough to penetrate well into the wood but not so long that they'll go all the way through,

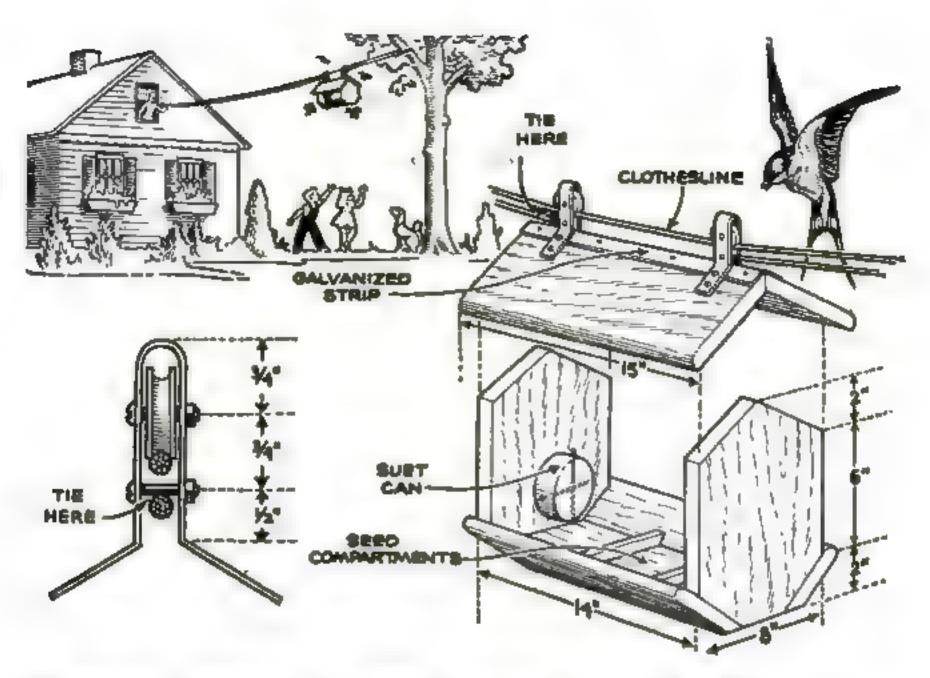
Now you can dye the bag. But first be sure to thoroughly clean the leather. Buy a leather-cleaning solution at a supply house and follow the directions. These cleaners usually are applied with a cloth. After removing the dirt and grease with the cleaner, you can apply the dye. I used shoe dye, but you can buy special dyes for leather if you like. The most common of these are andine dyes in powder form that are dissolved in hot water. After mixing, test the dye on a scrap before applying it to the set

As I dyed the bag, I kept a rag handy to wipe off the tack heads and hinges, I rubbed on a coat of ordinary floor wax and used plenty of elbow grease to give the leather a high gloss. Steel wool or brass polish will shine up the hardware.

Small Tractor Turns In Man-Sized Performance

JOBS too small for a full-size tractor are made to order for the Agricat . It'll get into places that a big tractor can't, but it still does a big job. One use is in filling trenches that a regular tractor would stradille. The Agrical rides in the trench and the bulldozer blade on the front spreads the fill The two 6" tracks contact 318 square inches of ground. Only 88" wide and 58" long, the midget stands 41" high and weighs 1,170 lb, A 60-hp, engine with two forward speeds and a reverse powers the tractor. Made by Earl H. Pence and Co., Inc., Berkeley, Calif., it's priced at \$875. In the photo at right, the tractor is shown pulling a 12" plow that cuts a 10" furrow. The swinging drawbar is set so the tracks ride out of the furrow. A manual lift raises the plow so it can be backed into corners.





Trolley Feeder Draws Birds Close to House

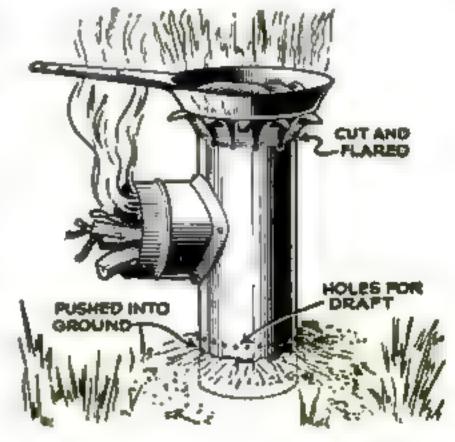
When this feeder is first installed, it should be left at some distance from the house until the birds are thoroughly familiar with it. Then, when they are coming regularly for their food, you can pull it closer to the house each day. Finally, the birds will be feeding right outside your window. Of course, the feeder must be pulled in from time to time to refill the seed compartments.

Use X" material for weight so the feeder

won't swing too much in a breeze. Shallow partitions are installed to prevent the seeds from piling up at one end. Suet is secured in a small can by a couple of wires run through at right angles. You can paint the feeder or just give it several coats of boiled linseed oil and let it weather. Note that both sides are open and the corners of the eaves and floor sidepieces rounded. Hangers are light strap iron.—Hi Sibley, Nuevo, Calif.

Pipe Tee Forms Camp Stove

LICHT and easy to carry, this little stove is ideal for short camping trips. It fits snugly into the trunk of your car or, on an overnight hike, it adds but little weight to a pack. An ordinary stovepipe tee is altered as shown in the drawing at right. The top is slit and flared so it'll take a large frying pan or a kettle. Holes are punched around the bottom to create a draft. These should be about 6" from the bottom of the pipe. Pushing the bottom end into the ground makes the stove stable. You can adjust draft by blocking some of the holes with earth. When you stow the stove in the car trunk, use the inside of the pipe to store dry kindling.-Victor H. Lamoy, Upper Jay, N. Y.



(2 REQ

Body and wrigs are carved only on one side. A 5" undercut brings head and neck away from background. A glass bead serves as the eve.

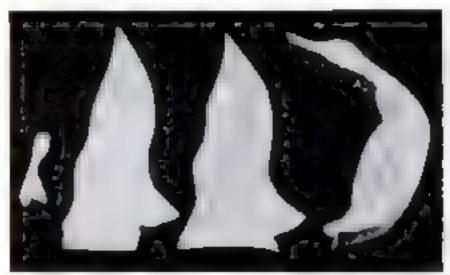
Miniature Game Bird Whittled from Pine

A CAME bird in flight isn't as difficult a carving project as it may seem. Actually, if done as suggested here, it's quite easy. Painted in natural colors, it brings a nice touch of outdoors to your den or living room. It has a flat back for wall mounting but looks like a full-round carving.

You begin by transferring the patterns to white-pine stock and roughing out the five pieces, body, two wings, and two legs, with a saw. Use %" stock for the body, %" for the wings and legs. Cut each piece with the grain running lengthwise.

Start the body carving by making a h" undercut back of the head and neck section. Then round out the body, paying particular attention to the shape of the head, neck, and bill. Muscles in the neck can be simulated by U-shaped grooves. Shallow cuts outline the tail feathers.

For each wing, outline the rows of feathers on the blanks with a pencil. Make a cut 1/16" deep at the start of each row. Taper the feathers upward from this point, keeping them the full thickness of the blank at or near the tips. Round off the tips of the



Roughing out the pieces with a saw saves a lot of whitthing. Use %" stock for the body, 4" for the wings and legs. Note how grain runs,

top bank of teathers and bring them to a graceful point. Outline all the feathers with shallow V-cuts.

The feet have an X-shaped cross section. Be sure to leave enough wood at the top of the legs for a tenon.

Cut the leg and wing mortise-and-tenon joints to a snug fit. After all parts have been sanded, glue them together. Use a little plastic composition wood to smooth over any apparent joints. When this has set, sand the bird again and apply a coat of flat white paint.

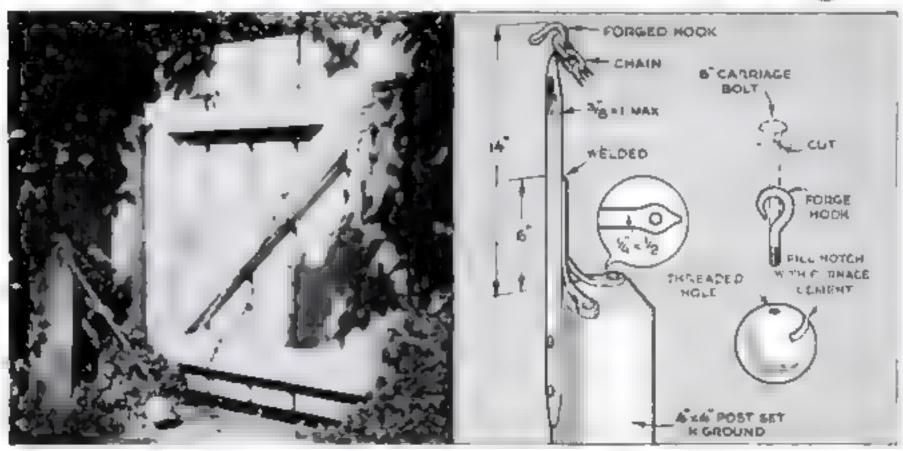
The finish coat may be either enamel or oils. If you're uncertain of the colors, you can probably locate a colored illustration of a mallard without too much trouble. Use a small yellow glass bead for the eye.

Attach a hanger on the back at the center of balance.—M. P. Casserly, St. Paul, Minn.



Wings vary slightly since you see different sides. Plastic composition wood hides joints.

Colonial Gate Closure Uses Furnace-Ball Weight



If you've ever visited Williamsburg, Va., you may have noticed the gate shown in the above photo. It's kept closed by a heavy ball on a chain. The chain is stapled to the gate and a strong post set near-by.

For your own yard gate you may like the

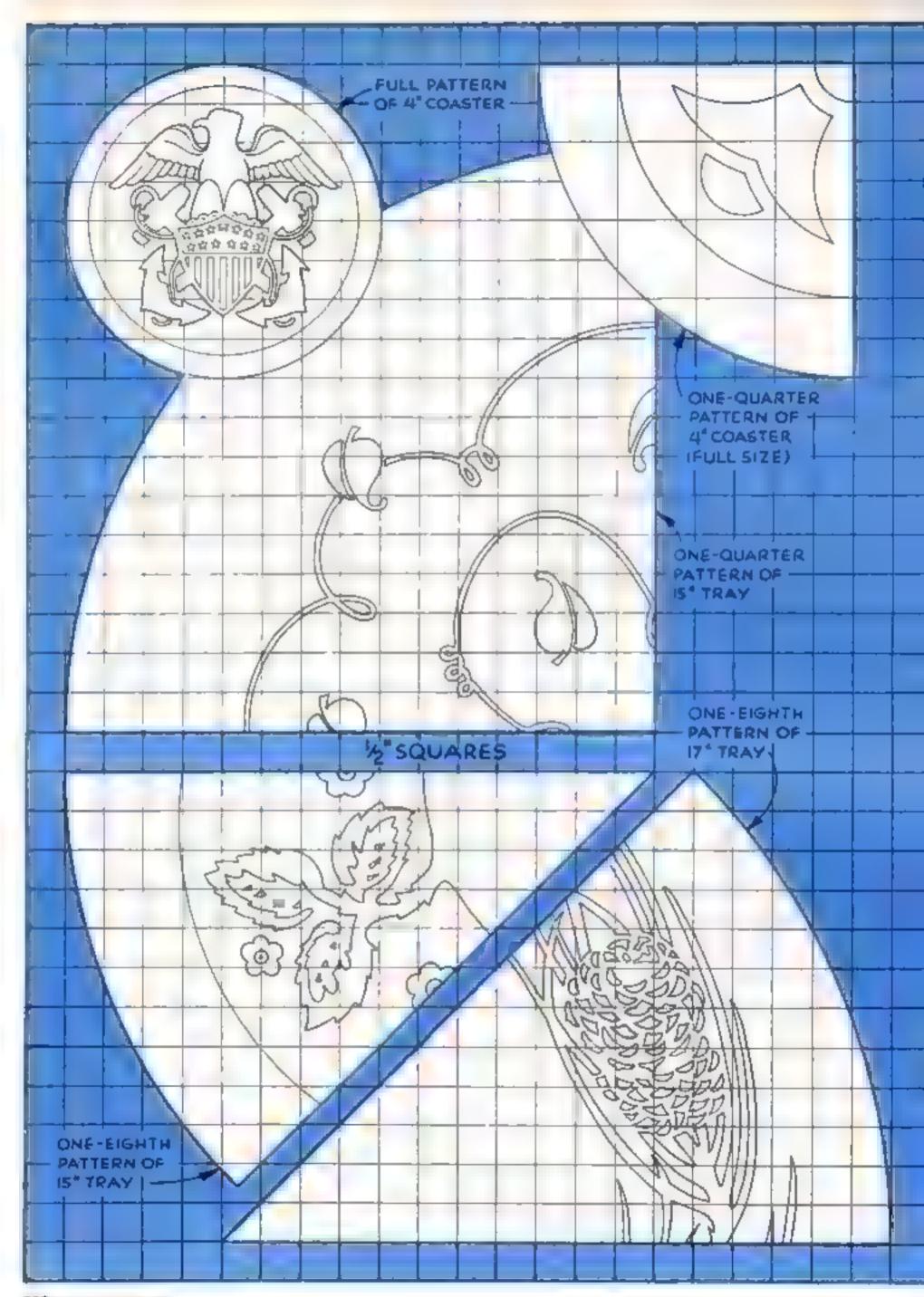
more elaborate staff in the drawing. You can make this yourself if you do blacksmithing. Mount it on a low post with matching forged pails. A furnace damper-control ball can serve as the weight. Forge a hook from a 6" bolt and turn into the threaded hole.

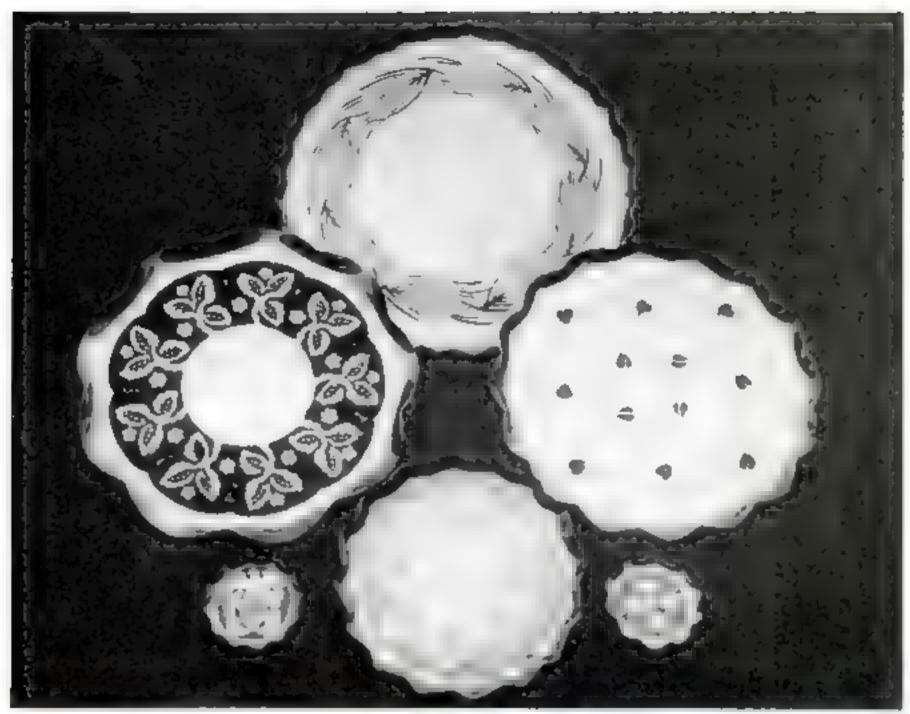
Steel Wool in Electric Drill Polishes Wood

For a fine wood finish, especially in crevices and on end gram, I wrap fine steel wool around a dowel and chuck the dowel in my high-speed electric drill.

Spread out wool about 2" wide and 4" long. Wrap this around a 3/16" or "."

dowel about 7" long. Start up the drill and brush the wool-wrapped dowel lightly against scrap wood to make the wool stick. Then apply another layer. Keep a light touch while using it. Wear goggles or a mask.—Roland Krebs, Webster Groves, Mo.





Aluminum disks etched with patterns of your choice make good counters, plates and trays,

IOW to Rich Amminan

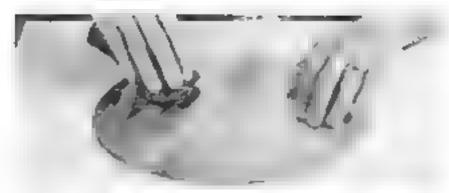
By Carolyn Placknett and Grace Schoeni

DECORATING aluminum is one hobby you can be sure your wife will approve. With a little encouragement she may even join you in adorning those inexpensive metal disks. In various sizes, finished aluminum circles make eye-catching coasters, ashtrays, candy or nut dishes, centerpieces, and cake or sandwich plates. When you have all you want, remember that etched aluminum trays are original gifts for almost any occasion.

Acid etches aluminum by uniformly attacking any part of the surface that has not been protected by an acid-resistant coating. Protected parts are thus left in relief. Of the major items of equipment, muriatic (hydrochloric) acid, and an acid-resistant substance such as asphaltum paint or varnish can be purchased from your local drug and paint stores. Aluminum circles from 2" to 22" in diameter are available from handicraft suppliers. Best thickness for the larger trays is 16 gauge; 18 gauge is adequate for medium and small disks

Remove the oily film on the aluminum with a scratchless scouring powder, and polish the surface with No. 0000 steel wool moistened with mild soap. Follow any apparent grain in the metal in both cleaning and polishing strokes.

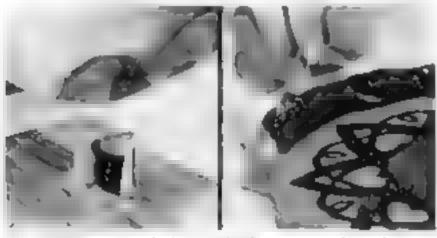
A simple way to plan a pattern is to cut a paper circle the size of the disk. Fold the paper into equal parts; the fold lines mark the points at which scallops in the rim will be turned up. Make the rim deep enough to hold the acid. For coasters and up to 15" disks, a minimum of 10 scallops will



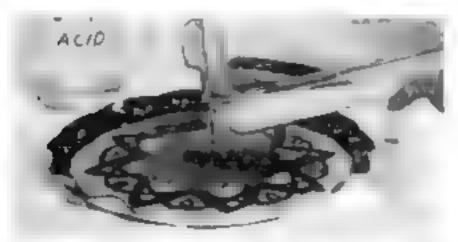
Polish the aluminum with scouring powder and a pad of steel wool loaded with mild soap.



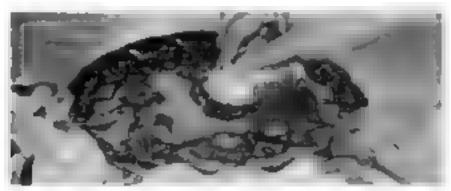
Work out the design on paper, tape it to the aluminum, and trace it off with carbon paper.



A bending jig, left, made from two dowel pegs and a scrap of wood assures uniform scallops. Paint the rom and the relief decorations with acid-resistant paint or varnish as at right.



Mix a solution of water and muriatic acid in a glass vessel and pour it onto the aluminum.



Remove the asphaltum from the etched tray with cleaning solution, applied with a soft cloth.

be needed, whus larger trays require 16 or more. Draw a circle on the pattern to allow for the depth of the rim and plan the design within that circle.

A geometric design is easy to make with a ruler and compass, and the center decoration can be a monogram, emblem, or a traced picture. After working out the pattern (several are drawn to scale on page 200), transfer it to the aluminum with grease carbon

paper.

Turn up the edges next to form the rim. This can be done with pliers if the jaws are well taped. A bending jig made from a scrap-wood base and two 2" pegs cut from %" or \$" dowels will form smooth and uniform curves. Drill two holes 1" deep to fit the dowels, placing them as close together as possible. Glue in the pegs and work sandpaper back and forth between them until the aluminum edge just fits snugly. With 1" of the pegs projecting, the jig will make uniform bends in larger trays. For smaller sizes, insert thin pieces of wood between the pegs to act as bottom stops. Three widths of these will locate disk edges %", %" and %" down from the tops of the pegs. To make a smooth rim, bend each scallop about halfway up; then go around the circle again to complete the job.

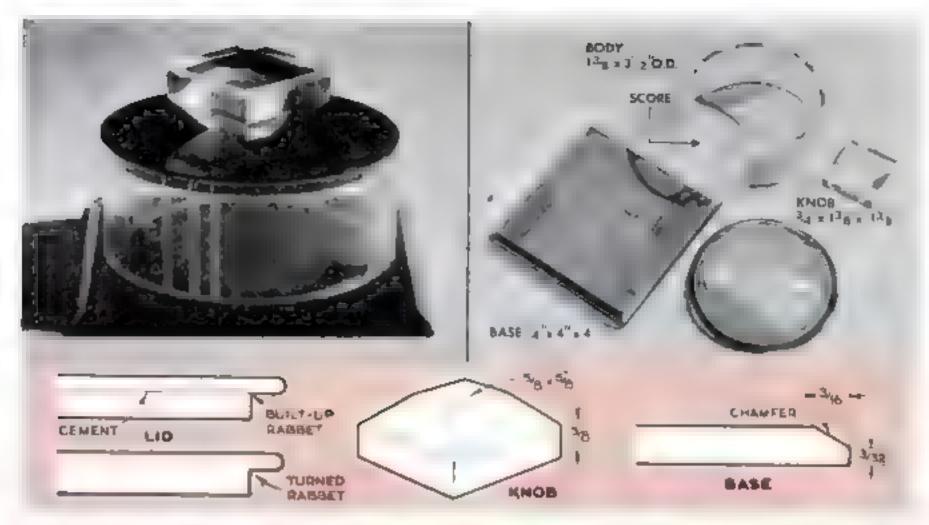
Paint the parts of the tray that are not to be etched with a thick coat of asphaltum. A small water-color brush is needed for delicate lines and a larger one for the large areas. If the asphaltum tends to run, thicken it by exposure to air. Should it get too thick, thun it with turpentine. Let the coating dry overnight. After it is dry, you can correct irregularities and draw in fine lines

with a sharp point,

To prepare the etching solution, carefully pour one part of muriatic acid into two parts of cold water in a glass container. Use caution in handling the acid. Always add acid to water, not water to acid. Avoid inhaling the fumes, and work near an open window. Acid cats away metal, so don't pour waste solution down the drain.

Pour acid solution into the tray to a depth of about %". If it boils too vigorously, carefully add water; if it shows no signs of boiling within 15 minutes, add more acid.

To test the depth of the etching, pour the solution back into the container, rinse the tray in cold water, and feel for a slight ridge When the etching is deep enough, rinse and dry the tray. Remove the asphaltum with benzine and a soft cloth.



Powder Box Combines Clear and Opaque Plastic

THE body of this simple box was cut from a stock cylinder and decorated with lines scored at equal intervals. A piece of %" stock, faceted and polished, forms the knob. Sand or file the bevels to 45 deg. The lid may be turned and rabbeted, or sawed round and the rabbet cut by routing the edge. To make it without power tools, saw two ¼" thick disks of different diameters. and cement them together.

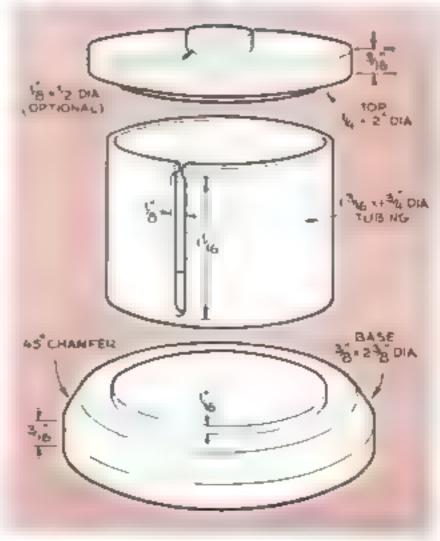
You'll have to cement the body to the beveled base. But if both knob and lid are opaque, they may be assembled with one screw after tapping the knob with matching threads. This climinates on extra cementing job if you build up the lid from two disks. The screw secures disks and knob. As a variation, you can heat-shape strips of plastic to form a bow in place of the knob.-M. J. Moch, Jamaica, N. Y.

Roll of Stamps Stored in Desk-Top Holder

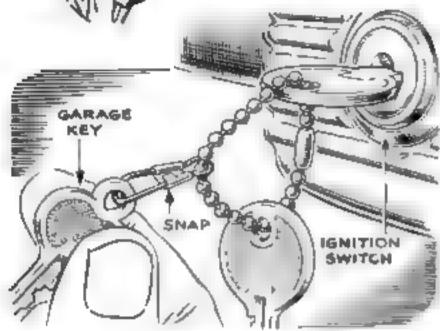


STAMPS in small books or loose sheets have an uncanny habit of getting themselves lost in a desk drawer. or else the loose ones stick to the drawer bottom or a piece of paper. The plastic and dural dispenser shown

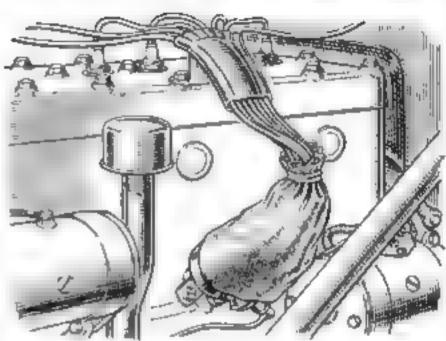
here keeps a roll of 500 stamps in sight on your desk top and also serves as an ornamental paperweight. All the dimensious are given in the drawing at the right. I cut the body from dural tubing, slotted it with a saw, and cemented it to the base. However, the body could be cut from a plastic cylinder The top is rabbeted to fit inside the body, or it may be made by cementing together two disks of different diameters. The decorative knob shown in the drawing is optional.— Joseph F. Gréce, Manhattan, N. Y.



Hints from the Model Garage



Garage Key Slips off Iting. It's always a nuisance if you must turn off the ignition and carry along all your keys when you unlock the garage door. This can be avoided if you have a quick, easy way to remove the garage key from the ring. Here's one possible way. The fishing-tackle snap shown can be bought in most tackle shops.



Sleeve Protects Ignition. If you have had trouble with the ignition shorting out during heavy rain, here's an idea that may help you. Cut an 8" section from an old inner tube, snap loose the distributor cap, slip the rubber sleeve over the high-tension wires, and replace the cap. Draw together and tie the sleeve at the topmost edge.



Get Off All the Streaks. Did you ever wash a car window and find when you're through that it's still streaked? H. R. Schaaf, of Louisville, Ky., says he has found it's best to use horizontal strokes of the cleaning cloth on one side of the glass and vertical strokes on the other. Then, if there are any streaks, you know at once which side they are on.



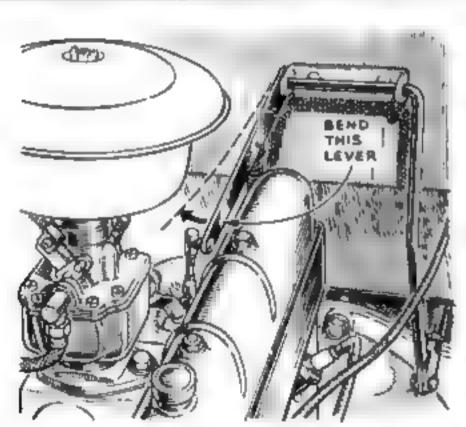
Sereen Catches the Bugs. For summer driving, a triangular piece of screening fitted into the area in front of the vent pane will catch any insects that are drawn in with the air. You can solder a heavy wire around the screening or just slip on slit wiper tubing as in the sketch. It's only a moment's work to slip out the screen and close the ventilator.



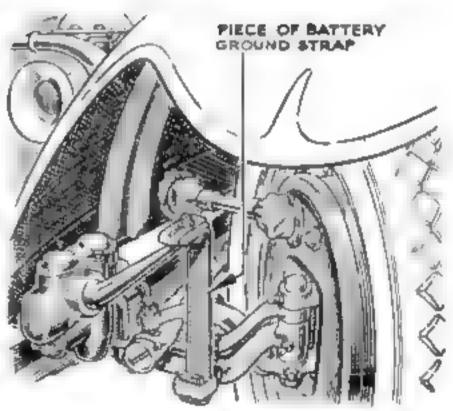
Door Open. Light Off. Door-operated dome lights can't ordinarily be shut off if you just want to park with the door open Wesley E. Charter, of Rockville, Conn., suggests that this can be done with a strip pivoted on one switch screw, preferably the lower one. It takes only a moment then to pivot the strip over the switch button.



Mirror Is Always Handys Here's the way W. M. Dierks, of Chicago, filled the bill when his wife asked for a convenient intror for use in the car. Buying a large compact, he mounted it as shown inside the glove-compartment door, drilling holes and attaching it with screws. While not in use, the compact is kept closed.



It Wasn't a Ghost. On right turns, Eric St. Clair, Richmond, Va., found his Crosley accelerating of its own accord. He traced the cause to contact between the throttle linkage and camshaft cover. Bending the link cured the trouble. His explanation: On right turns the engine mounting was flexible enough to let the camshaft cover bear against the linkage



Strap Repairs Shock Absorber. This is how E. V. Collins, of Bantam, Conn., repaired an old-type shock absorber when the web strap broke. Unable to buy a new one, he tried woven brake lining but it soon broke. Then he used woven copper braid made for ground straps on batteries, installing it as shown in the sketch. It's given good service ever since

There's Magic in Chemistry

CHEMISTRY is usually a serious business, but it can also be a means of entertaining your friends. With a few common chemicals you can perform a number of apparent feats of magic. The ordinary magician must depend on sleight-of-hand to get his effects, but that's not true with chemical magic. There are no tricks involved. You just take advantage of natural laws. Here are a few of the chemical feats you can perform.



Clear Solution Turns Blue. Dissolve & gram sodium or potassium iodate in a little water and add more water to make 225 ml. Set this solution aside. Then make a starch suspension by mixing 2 grams starch with 100 ml, water and bringing to a boil. After filtering, add this to a solution of .2 gram sodium sulphite in 50 ml, water to which you've added 1 ml, dilute sulphuric acid (1 part concentrated acid to 50 parts

water). Add water to second solution until you have 225 ml, Allow to cool,

Put some of the first solution in a beaker and add an equal amount of the second while stirring. Then stand aside, make a few passes with your hands (at the time you've determined by experiment beforehand), and the clear solution will instantly turn to ink. Indine, set free, reacts with the starch, forming the blue coloration.



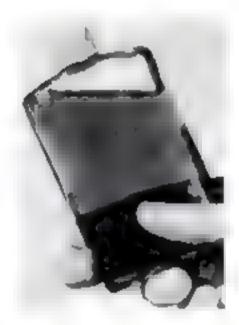
Write in Color. Here's a case where you write on white paper with a finger moistened in water—and each line comes out a different color.

Prepare a sheet of coarse-grained white paper beforehand. Into the top third rub a dry mixture of equal parts tannic acid and ferric ammonium sulphate. In the middle area repeat with a similar mixture of so dium salicylate and ferric ammonium sulphate. Treat the lower third with sodium ferrocyanide and ferric ammonium sulphate



It Grows Whiskers. If you write on aluminum foil with a glass rod dipped into a water-clear solution, white whiskers will sprout from the letters

Be sure the foil is free of grease. Do the writing with a saturated solution of mercuric chloride. In a few seconds, blot off any excess with a paper towel. The mercury amalgamates with the alumnum and the latter reacts with oxygen in the air, producing the fuzz. This solution is very poisonous, so wash your hands thoroughly.



Dark Solution Clears, You can turn what seems to be root beer to a water-like liquid without opening the bottle

Make the "beverage" by adding tincture of inchine to water. If the bottle has a cork, press a few crystals of photographic "hypo" (sodium thiosulphate) into a hole cut in the inside end. If it has a screw cap, attach the crystals with glue.

To work your "magic," merely shake the bottle a few times. As soon as the hypo dissolves, the liquid becomes colorless.





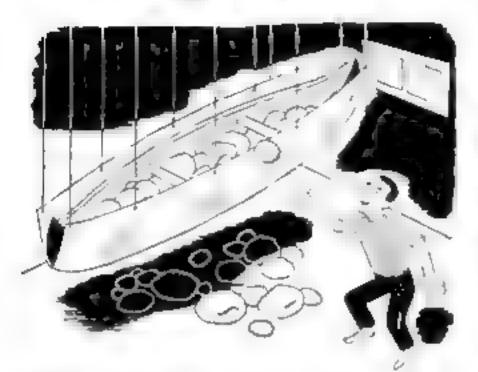


Clean Hand Leaves Mark. In this puzzling trick, a clean hand is pressed on a sheet of white paper. When the hand is removed, a print remains on the paper.

Get ready by rubbing powdered tannic

acid into coarse-grained paper. Just before performing, secretly moisten the palm of your hand on a cloth wet with ferric chloride solution. When in contact, the two chemicals form a black compound

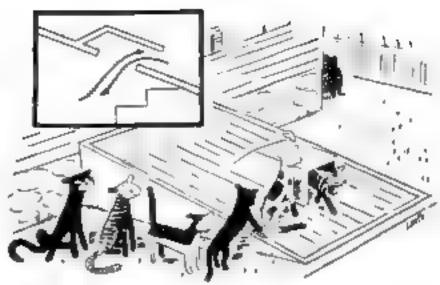
What's Your Ingenuity Duotient?



Rocks in my head was what a friend thought I had when he saw me putting rocks in a canoe. I'd salvaged a badly damaged canoe, and to re-cover it, I ran wire hooks through the edges of the canvas and nailed the other ends of the hooks to ceiling beams. Then I wet the canvas and placed the canoe in it. The rocks were for additional weight to stretch the canvas tight. —F. G. Semple, Ottawa, Ont.



I have nothing against water, if it stays in its place, but I don't like rain blowing in on me while I'm trying to sleep. So I hooked up a weight and a piece of blotting paper that releases my window catch when it rains. A spring pulls the window closed. Water causes the blotter to tear and the weight pulls the catch down. -W. M. G. Fernando, Colombo, India.

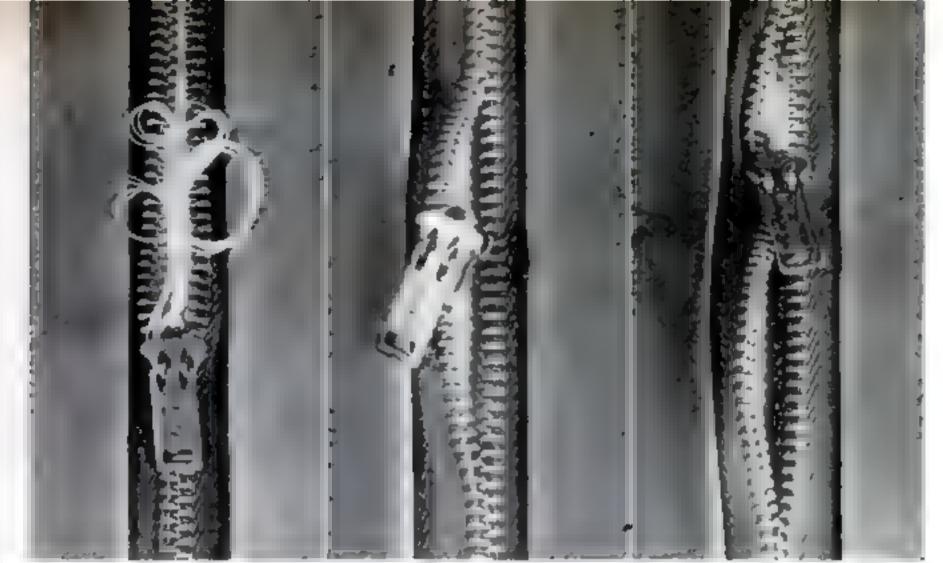


We've got so many cats that I found myself working overtime opening the door for them to trot in and out. But not any more. With a few scrap boards about 3' long, I built a tunnel to fit over an 8" by 10" hole that I sawed in the cellar door. The tunnel keeps rain and snow out, but the kitties can parade in and out any time.—Oruille Grisser, Denver, Colo.



Replacing one of our high-ceilinged light bulbs used to be a big production—lugging a stepladder from the garage, setting it up, putting in the new bulb, and lugging the ladder back to the garage. But now I let my tank-type vacuum cleaner do the job. With the dusting attachment on the end of the metal extension tubes, the suction holds the bulb while it's screwed in the socket.—Mrs. Hal Geilim, Aurora, Ill

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works. Use government postcards only. Contributions cannot be acknowledged or returned.



Zipper trouble usually occurs in one of three forms. You can make a repair in each case.

What to Do When Zippers Won't Zip

FIXING a slide fastener is not always as simple as sewing on a button, but it usually can be done. The job pays, too. You often can salvage an item that has been cast aside as useless.

There are some cases, however, where you may just as well give up any thought of repair, rip out the old tape, and install a new fastener. For instance, you can't do much with a plastic zipper or one that has lost any teeth.

But beyond this, you have a big field of possible repair operations. If thread or other material has jammed the slide, you may be able to cut and pull it out. If not, pry the jaws of the slide apart until it can be moved.

Prying the jaws apart means that they will be out of line, so you have to realign them. In fact, a deformed slide is the major cause of supper disorders. Unless the jaws are strictly parallel, the slide may jam, come off one row of teeth, or fail to draw the teeth together into locking position—as seen above.

In such cases, it's advisable to remove the slide so that you can compress or pry apart the jaws to make them parallel, as shown in the drawing on the next page. After the slide has been straightened, you face the job of locking the teeth together before replacing the slide. This can be done by hand, but it calls for lots of patience.

Start at the bottom, holding just the ends of the rows between thumbs and forefingers, Roll the teeth together so they mesh much like gears, remembering that you can engage only one pair at a time. When you move up to a new grip, keep a tight hold on the



Slide must be removed for most repairs. To do this, begin by prying apart the jaws at the open end of slide, using a small screwdriver.



Next cut loose the ends of the fastener tape with a razor blade. Cut only a few stitches, just enough to free the end of tape.





Pry off the zipper stops. These are usually clamped to the tape rim. You can now remove the slide (center) and bend the jaws true. If the fastener is the separating type that opens

at the bottom (above right), the slide is simply slid back on the row of teeth with the large bottom stop. On nonseparating zippers, teeth must be closed to get slide on from top end.



Special tool was recently introduced by Morehelp Products, Lakewood, N. J., to aid in zipper repair. As seen above, it pulls the two rows of teeth together. The repaired slide can then

be replaced (center). When you make any repairs to a zipper, the jaws of the slide must be exactly parallel. If they're not, pry them apart or pinch together as required.

last teeth closed, or you'll find yourself doing the whole chore anew

A special tool, shown in use above, will enable you to do this job in a jiffy. With it, you can lock the teeth just as you would with the slide itself.

When all teeth are closed, push the slide on the two rows at the end where you've ripped the tape loose. Once the zipper is working properly, replace the original stops If this proves too difficult, stitch in thread stops.—Arthur C. Miller, Manhattan, N. Y.

Gear-Tooth Meshing Is Secret of Zipper Action

BENDING
SEPARATES
ADJOINING TEETH

Look closely and you'll find that each tooth of a shde fastener has a dimple on one side, a hook on the other. It's plain that one fits inside the other to close the magic seam that stands cross pull, yet unzips at a touch.

But how? Take one row of teeth in your fingers and bend it into a flat loop, teeth out. See how the points of the teeth get farther apart at the curve? That's the secret.

The slide is so shaped that it feeds the two rows of teeth into each other, holding opposite teeth as if the entire row were curved. This lets one hook and one socket engage at a time.

Once engaged, they resist a strong crosswise pull. But unhook the first two teeth, bend the tape, and the teeth come loose one after another.

Hand Tools Build Modern Table

By Leopold Newman

Author of "Waailworking Mude Easy"

UNLIKE the old saw about a square peg in a round hole, this table was built by putting round holes in square panels—but without a saw.

That's the most unusual feature of this double-decked coffee table—the four circular pieces that make up the top and shelf. They were made without use of a saw. Using 5/32" plywood, I secred tangents to the circles and snapped off the pieces. I continued seoring and snapping until I had a rough circle. Then I sanded it smooth and round. Of course if you have a coping saw, you can put it to good use

The materials cost about \$8. Here's what you'll need: four 25" squares of 5-32" birch plywood; three 1%" by 21" dowels for legs, a few long 1%" strips of the plywood; some narrow 1%" stock for spacers; and some finishing nails and glue.

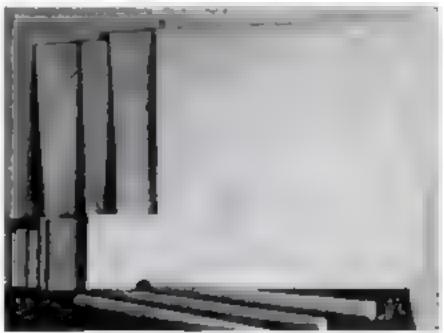
On two of the plywood squares, draw

1. After scribing circles on each of the four squares, draw tangents. Mark across the ends of the tangents with a broleum knife to locate them on the other side.





Modern coffee table built with hand tools and \$8 worth of materials. Top and shelf are four pieces of 5/32" plywood shaped without a saw, lanes were secred and pieces snapped off.



Here are the principal parts: four 25" square panels of birch plywood and three 13" by 21" dowels for the legs. Strips of the smaller plywood pieces formed rins around top and shelf,

2. Draw identical tangents on both sides of the panels. With a straightedge as a guide, score the lines three or four times on each side and break off the triangles.





3. After snapping off the four large triangles, draw more tangents, score them, and break off the waste. Continue until you have a rough circle. Always score the tangents on both sides.



4. With a block of wood and sandpaper, work around the rim of each plywood disk until you have a circle. Two disks are 25" in diameter and the other two are 24 5/16" in diameter



7. Nail and glue spacers to the large disk with holes in it and to one of the shelf disks. Fasten other disks to spacers. Make certain that the cutouts in the shelf disks register.



8. To close space between the disks, nail and glue long strips of 5/32" plywood to spacers. These strips must be cut so that the grain on the outer plies runs the short way.

rough circle. Sand it smooth and round.

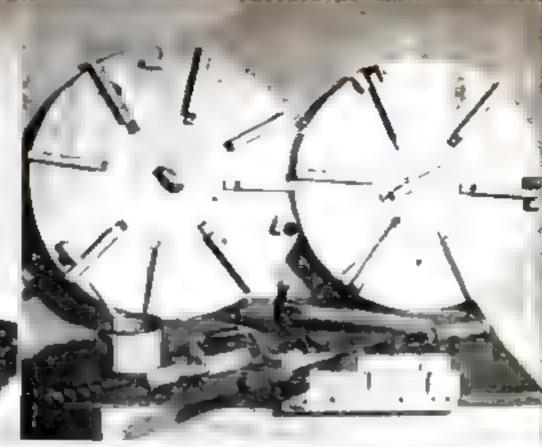
circles of 12%" radius. On the other two squares lay out circles of 12 5/32" radius. Then draw tangents to the circles. These tangents must be drawn in identical positions on both sides of each square. Then with a steel rule as a guide, score the tangents on both sides. Make three or four cuts along each line. The triangles left by the scoring will break off easily. Continue scoring and breaking until you have a

Center the two small disks on one of the large disks. On the edge of a small disk lay out three marks spaced 120 deg, apart. On each mark center a 1%" bit, spotting it so that in the smaller disks, the bit will make a semicircular cutout. In the large disk, the bit will make a hole close to the edge. Bore

a hole at each mark, taking pains not to tear the edges.



5. Center the small disks and one large disk with a raul. Hold them with another raul. Drill three evenly spaced 1%" holes, centering the bit on the edge of a small disk.



6. Bit will make senuercular cutouts in small disks and holer in large disk. Spacers shown here were built up of scrap to total exactly 1", but 1%" stock could be used



9. Glue and nail, or serew, the legs to the top and shelf. Use three 10" spacers to position the shelf accurately. So k all nailleads, fill the holes, and sand the table smooth.

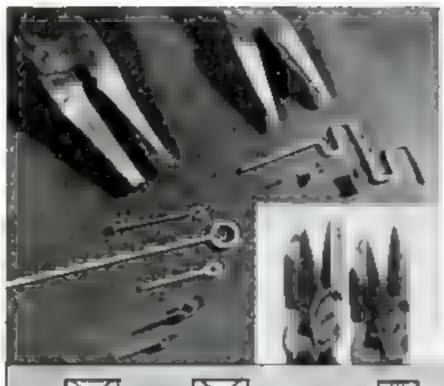


10. The table pretured above was firshed with enamel. Then a falme cover to match the drapes was put on the top and a piece of plate glass used to protect the falme.

Next cut up the 1%" stock into 11 pieces 2" long and 14 pieces 6" long. Nail and glue eight 6" spacers to a large disk—the one with the holes. Space them equally and with the ends flush with the edge. Also nail and glue six 6" spacers to one of the shelf disks. The 2" spacers are used as supports for the centers and legs as shown in photo No. 6. Sandwich the spacers between the disks with glue and nails.

Cover the space between the disks with strips of the 5/32" plywood. These must be cut across the outer grain so they'll bend around the rims. Nail them to the spacers and use glue around the edges of the disks. Nail and glue, or screw, the legs to the top and shelf, To position the top and shelf properly, I cut three pieces 10" long and used them as spacers until the legs were nailed in place.

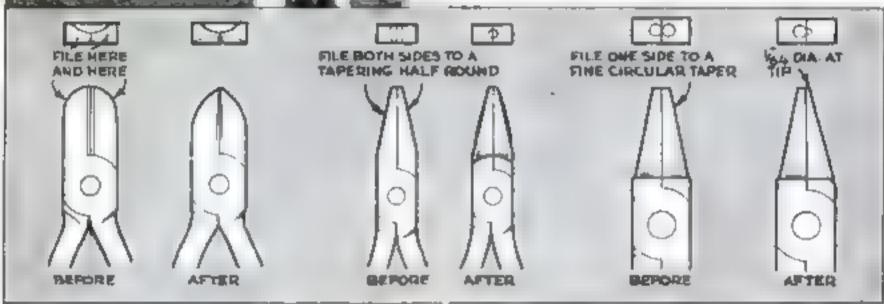


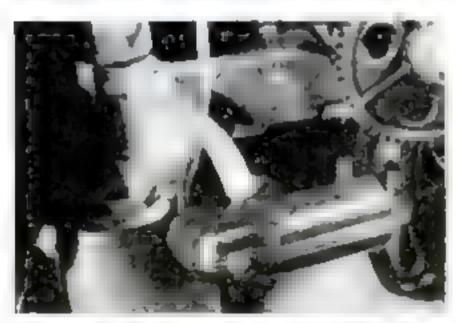


Tailor Your Own Tools. A modelmaker often has trouble finding tools fine enough for his needs, but existing tools can frequently be adapted to suit. In the drawing below are three examples

At the left, electrician's cutters were filed down to serve as chippers. With them you can cut off pins practically flush with the work

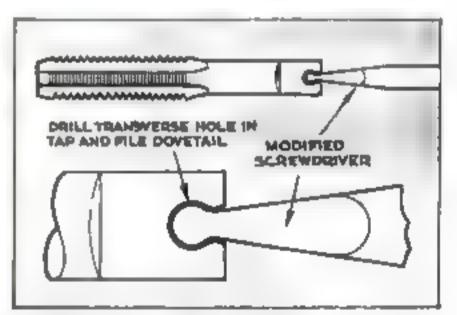
At the center flat-nose machinist's phers were filed to a tapering half round. In this form, they surpass tweezers for handling him work. At the right, one jaw of a pan of round-nose bending phers was filed almost to a point. With this tool, you can bend the many traveves and hooks that add detail to models. File, don't grind the tools. Herbert Pfister, Bronx, N. 1





Magnet Holds Light. Here's a useful trouble light for home shops. A small horseshoe magnet keeps it in place

In addition to the magnet, you need a plastic night light intended for plugging into a wall outlet. Solder leads to the prongs on the light and wrap with insulating tape. Bolt or solder one end of a short strap of brass to the magnet and screw the other to the light. The strap can be bent to position the light where you want it.—Will Thomas, Kenmore, N. Y



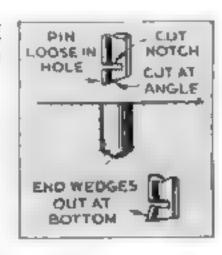
Tapping a Deep Hole. This idea came to me when I faced the problem of clearing damaged threads at the bottom of a 6" hole—and had no tap long enough to reach. A modified screwdriver blade, locked to the tap shank as shown, did the job.

The same procedure can be used to tap new threads in soft metals if you don't overload the flutes and remember to apply plenty of oil.

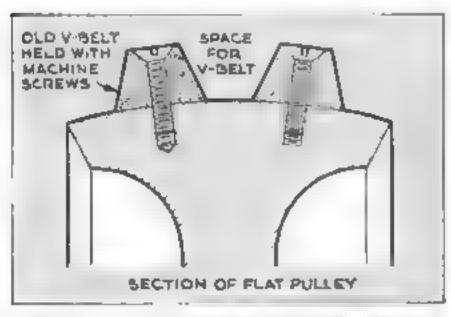
Be sure the screwdriver point is not brittle.—E. B. Bourassa, Nashua, N. H.

Placed on your micrometer in a moment, this attachment provides an accurate method of measuring taper per inch. It consists of two main parts—a clamp and an end-piece. The clamp fits over the outer jaw of the micrometer. After a measurement is taken in position "A", the endpiece is swiveled to position "B," the work advanced to touch it, and a second measurement taken. Since the distance advanced is exactly 1", it follows that the difference in measurement is the taper per inch.

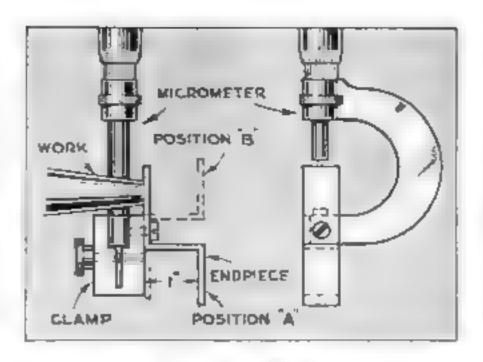
An elloring
Loose Pin. When
a drive-fit pin has become loose because it
or the hole is worn or
out of round, this
method will enable
you to reset it. The
pin may not be as
tight as a new one.



but in most cases the procedure will save time and material. Saw a notch near the bottom of the pin and cut this end at an angle. When you put the pin in the hole and hammer it down, the bottom will wedge outward, increasing the effective diameter of the pin.—O. Fluharty, Indianapolis, Ind.



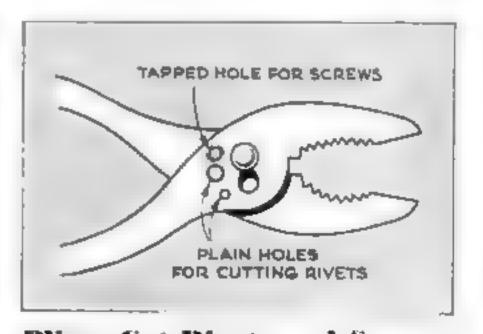
Pulley Adapted for V-Belt. In the shop where I work we needed a large V-belt pulley to drive a big blower, but there was none at hand. Instead of trying to buy one, we took a large flat pulley and screwed around it two lengths cut from an old V-belt. These were placed with the widest surface down and spaced just far enough apart to fit the V-belt we intended to use. On an extra wide flat pulley it would be possible to make spaces for two or more V-belts.—George A. Kramer, Compton, Calif.



Bearing Supports Shaft.
When you must turn
down a long splined
shaft or one that has
an existing keyway or
slot, it's next to impossible to use a
steady rest. The problem can be solved by
selecting a ball bearing with an inside



diameter equal to the shaft diameter, slipping it over the shaft, and adjusting the steady-rest jaws to the bearing. Square or hexagonal bar stock can also be supported this way.—J. C. Martin, Kings Point, N. Y.



To clip small rivets and screws without damaging the ends, drill holes through both parts of a pair of ordinary phers, locating the holes near the pivot. The holes should be drilled, of course, while the phers are part way open. The phers I use for this purpose have three holes of different sizes, one being threaded for an 8-32 screw. After a screw is turned in and clipped, the threads clean the end when it is removed.—J. H. Stevens, Elizabeth City, N. C.



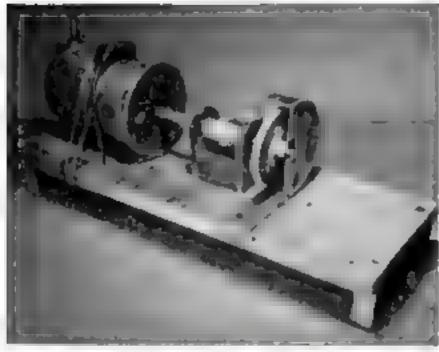
Vacuum-Cleaner Motors Run Power Tools

FOR 12 Lobs actual the shop a victimcleaner motor is hard to beat. Although these AC-DC series-type motors are busky enough to drive standard lathes, saws and similar power tools, they are practicable for light grinding and buffing and for operating a high-speed flexible-shaft. Then, toothey'll take over such miscellaneous shop chores as driving a darkroom ventilating fan, supplying air for a gas torch or a smelting furnace, or driving a sensitive drill or a watchmaker's lathe. Not the least of their virtues is cheapness. They're often available in secondhand stores for a few dollars

If possible, make sure the motor is in running condition before buying it: a short in the americal or field coils will make it hardly worth repair. With old motors, the commutator may be no poor shape, but this can be corrected by a light skimming cut in a lathe and by undercutting the mica if necessary. Don't forget in disassembling the motor that the fan nut often has a left hand thread. Replace the brushes if they're worn short, taking care to orient the curved brush surfaces properly.

A photo at the top of the facing page shows one motor used to drive a small bench grinder and polisher. It's mounted on a 'l' plywood base. Rubber pads were placed beneath the motor to align its shaft parallel with the base. Then it was ned down tightly by stranded steel wires running to a pair of small tumbuckles underneath Short lengths of hardwood dowel between the wire and base give clearance for tightening the turnbuckles.

Because the shaft had both shake and end play, a small ball-bearing arbor was devised. It's a short length of X" pipe bored out at



Bench grinder and polisher driven by vacuumcleaner motor. Mounted on rubber pads, motor is anchored by stranded steel wires.

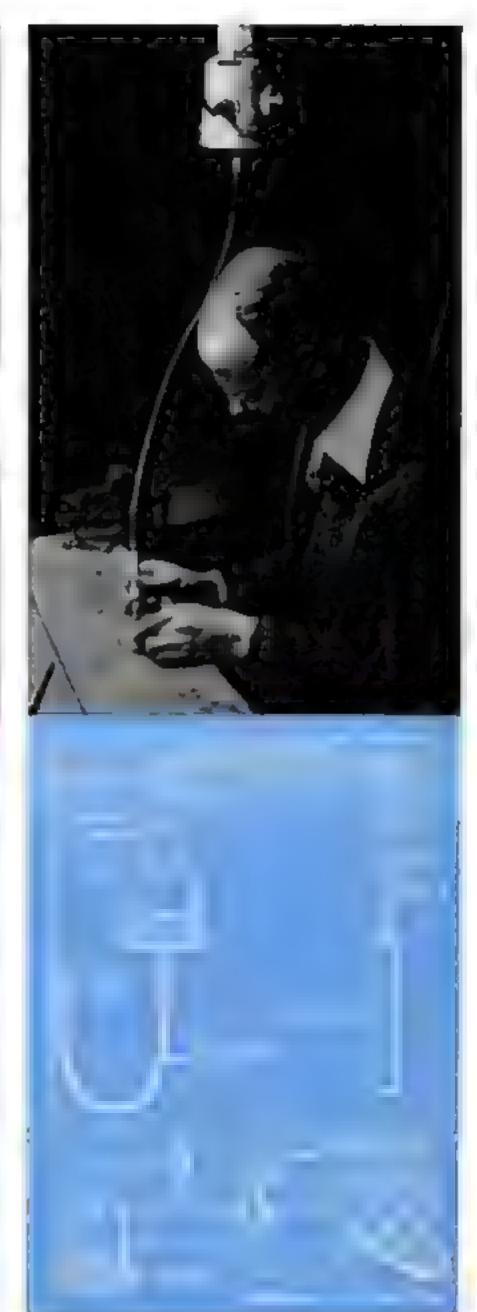


Rheostat of 50-watt rating will control cleaner motor if a small fan is hooked up to blow heat away from the resistance coil.

each end to take the bearings and held by two recessed plywood endpieces. The shaft, a piece of 5/16" drill rod, was threaded in a lathe for the clamping nuts, to help get a wheel that would run dead true. Rubber hose makes a good motor-to-arbor coupling. A sheet-metal wheel guard is used during grinding.

Another excellent application for these motors is powering a flexible-shaft tool. Here the high speed of a series motor is especially helpful. So is the extra power of a vacuum-cleaner motor, which has more beef than small commercially made flexible-shaft outfits. A bench mounting can be used, but a counterbalanced overhead support is handy and compact. When you want to use the tool, just reach up, pull down the hand-piece, and turn on the juice.

Two pulleys, a bracket, a length of rope or furnace chain, and a counterweight are all you need for this mount. Another short piece of chain keeps the motor from turning as a result of reactive torque. The power cord to the motor is given enough slack to



Flexible-shaft tool powered by vacuum-cleaner motor is shown being used in top photo. Diagrams show setup of wiring and parts. Safety chain also keeps motor from rotating

permit vertical movement. A tool clip screwed to a joist holds the handpiece.

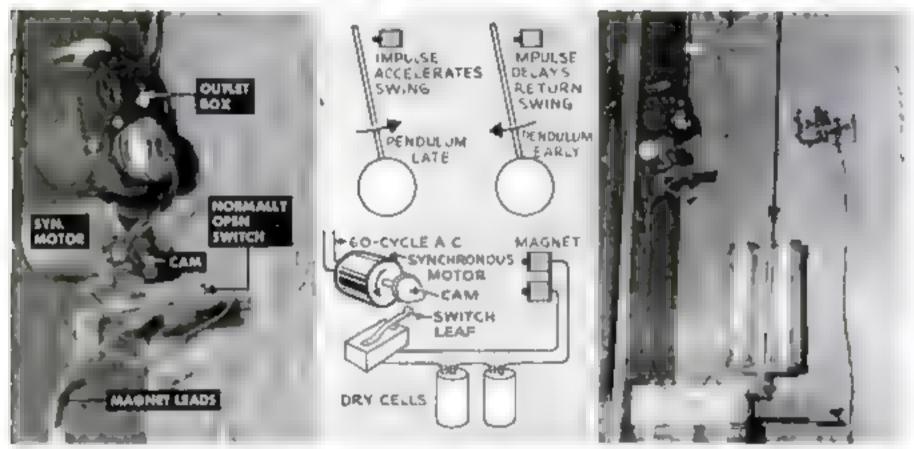
Speed control of universal motors is important. Such motors should never be connected across full line voltage except under load. Connected to full voltage without a load, the speed may build up until the armature windings loosen. The simplest, but perhaps least satisfactory, speed control is a lamp socket wired in series with the motor. Depending on the nature of the load, 60-, 75-, or 100-watt bulbs are screwed into the socket. If the voltage is AC, a better control is a variable reactance. (PS, June '45, p. 190.)

Probably the best speed control is a

heavy-duty rheostat of about 100 ohms maximum resistance and 100-watt rating A rheostat made to control a sewing machine will serve. It's possible to use one of only 50-watt rating by mounting a small fan directly behind the rheostat. A small shaded-pole motor is mounted so that the blades blow the heat away.

Whatever speed control you employ, you'll find that a normally off footswitch is ideal. In grinding and buffing the load is intermittent and if you cut down the voltage so the motor won't run away when the load is off, you'll have inconveniently little power when the load is on. Here a footswitch lets you use full line voltage.

Magnet and Motor Regulate Pendulum Clock



installed on a spring-driven clock in an industrial plant—keeps the clock in perfect time but still allows it to run by itself if the power fails. When the power resumes, the device again automatically takes over the job of regulation. Of course, the clock must be kept wound; the electric power serves simply as a regulator. After a power failure, the only error in time will be the very slight one that may have developed while the clock was running by itself.

For a fraction of a second every six seconds the double-pole magnet is activated just as the pendulum reaches it. If the pendulum is swinging too slowly, the magnet, activated shortly before the pendulum reaches it, tends to pull the swing into step. If the pendulum is swinging too fast, the magnetic impulse comes slightly later and tends to hold back the pendulum's next swing.

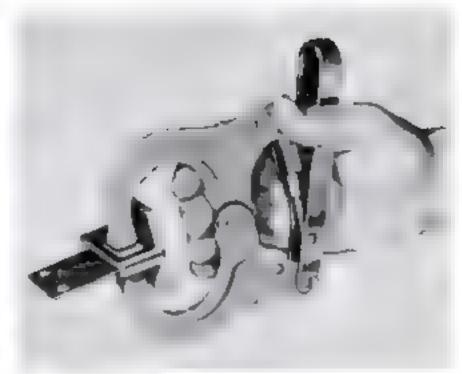
In the left-hand photo may be seen the self-starting synchronous motor. It momentarily closes the normally open cam switch every six seconds. The switch contacts are connected to dry cells and thence to the magnet. Instead of each six seconds, the motor could be one that operated the switch every two seconds or a multiple of two.

First the clock is regulated closely when running by itself so the magnet has as little as possible to do to keep it in time. In the event of a power failure, the clock may gam or lose time, depending on how accurately it was regulated. It's highly improbable that the timing device and the pendulum will be in synchronism when the power returns, but if the gain or loss is not over six seconds, they'll come together again.—

A. W. McAuly, Pittsburgh, Pa.



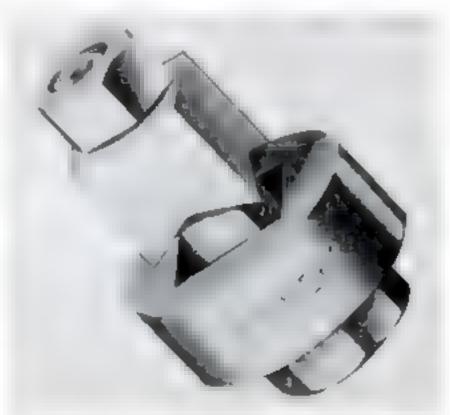
Drill Drives Spray Gun. Any standard X" electric hand drill can be used to power a compact, self-contained compressor and spray gun announced by the F. R. Williams Company, Chicago. Weighing only 8 oz., the unit consists of an aluminum alloy casting fitted with bronze bearings. A steel strap clamp holds the paint container to the compressor, making it easy to remove the container for filling with paint.



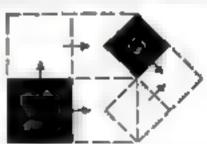
One-Hand Clamp. The jaws of this clamp open sufficiently so it can be used on material up to 1%" thick. An adjustable toggle handle enables you to put the clamp in position and lock it with one hand. The U-shaped jaws fit over angles, rolls, and other raised edges, and hold on either flat or irregular surfaces. Called the Quick-Action Clamp[®], it's made by Roesch Tool Products, Los Angeles, Price is about \$2.75.



Jigsaw Overarm Is Removable. A new 24" jigsaw manufactured by Atlas Press Company, Kalamazoo, Mich., has an overarm that may be quickly unbolted to permit sawing large panels with saber blades. Another feature is a drive shaft that turns on ball bearings. The 14" by 14" iron table is supported by large trunnions spaced nearly 10" apart to provide firm support for heavy stock. Chucks that take all types of blades and sabers up to 5/16" wide and files up to %" give the tool a high measure of versatility. Maximum depth of cut is 24". Four-step cone pulleys afford speeds of 570, 858, 1,220, and 1,658 strokes per minute with a 1,725-r.p.m. motor.



Metal Punch. A punch which is distributed by the Pioneer Broach Company, Los Angeles, cuts square holes in sheet



metal by screw action. It can be used to cut irregular openings, as seen in the sketch. The punch applies a double-action shear on each side of the metal as the nut is turned up with a wrench. A round hole is first punched for the screw bolt. The tool is made in two sizes, %" and %" square.



One side of the room includes a built-in desk, file cubinet, and bookshelves. For diffused light, frosted glass was placed in the window.

Opposite corner is devoted to darkroom work. The bench is built at a comfortable working height. There's shelf space for all equipment.

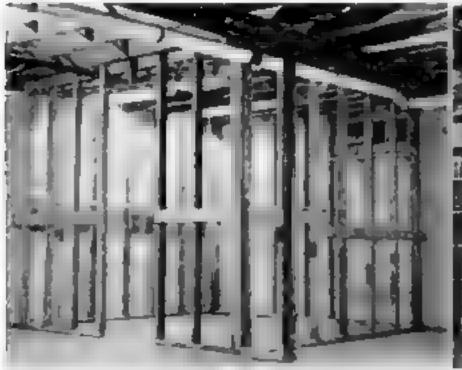
Den and Darkroom Built in Basement

By Arthur M. York

GIVEN space in a dry basement, there's no reason you can't do exactly what this man did. A photographer and writer, he

wanted to move his photo operations out of the kitchen, and he needed a personal retreat where he could work in peace

He solved both problems by building a combination den and darkroom in an unused



A basement corner gave space for an 8' by 8' room. Holes were drilled in the cement floor and the frame anchored with expansion screws.



Wallboard nailed inside the framing finishes off the room. Two-by-threes were used for the frame. Door was built of pure and wallboard.

corner of his basement. Surprisingly enough, considering today's prices, he spent just a trifle less than \$75 for materials.

His 8' by 8' room is not just a hole-in-thewall either. It includes a built-in desk, book shelves, photo workbench, recessed lighting, and ample room for a file cabinet and chairs.

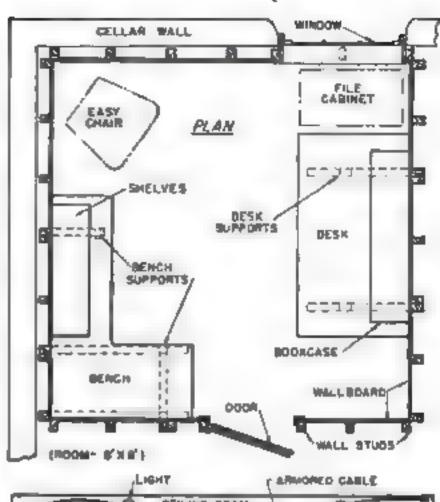
Although running water and sink are not provided inside the room, this offers no particular hardship. The laundry tubs are located just outside the door. Photos are washed there

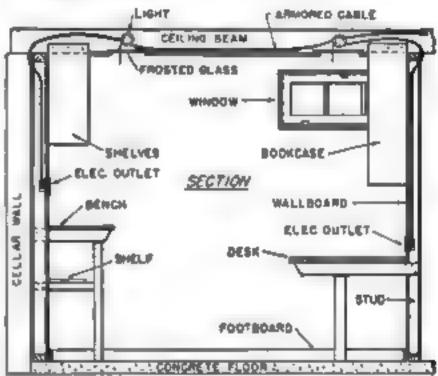
The room was framed with two-by-threes, the stude being spaced 16" apart. This lumber, incidentally, accounted for the largest single item in the cost—about \$21.

After the frame was up, the electric wiring was taken care of. About 30' of armored cable was required for this, provision being made for three ceiling lights and two convenience outlets.

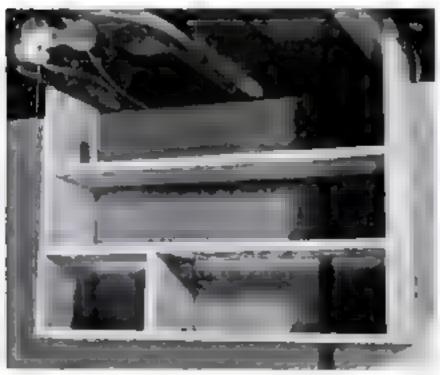
With the wiring complete, the walls and ceiling were sheathed with 5/32" fiber wall-board. Joints were sealed with ordinary gummed paper tape, A 3" kickboard was placed around the base and all wall and ceiling corners finished off with \$" quarter-round.

Rather than buy expensive lighting fixtures, the builder decided to install recessed lighting—over the desk, workbench, and easy chair. Low-cost porcelain sockets were installed between the ceiling beams at these locations, and square openings cut in the ceiling sheathing just underneath. A metallic hot-pan mat from the dime store was placed above each light to serve as a reflector. Bulbs can be replaced by sliding back

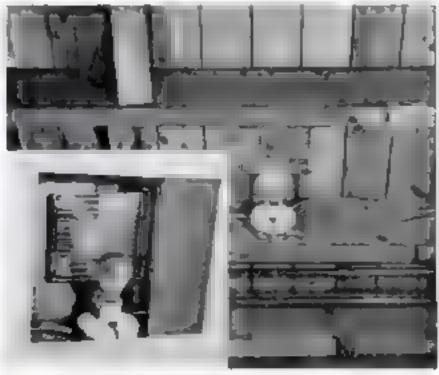




Careful planning made good use of the limited space. A cellar window was included within the room to give ventilation and some natural illumination. The concrete floor was painted.



Hanging shelves on two sides of the room save floor space. These were nailed to the overhead beams before ceiling sheathing was installed.



Wiring was done before putting up wallboard. Inset shows one of three concealed lights in the ceiling. Frosted glass rests over opening.



A removable cover blacks out the window while photo work is in progress. It consists of a wood frame covered with a piece of wallboard.



The desk is simple but sturdy. Two horizontal members were nailed to the wall study. The pine top was covered with wallboard and painted.

the frosted glass that covers the enclosures.

Side members for the bookcase and shelves were nailed to the ceiling beams before the sheathing was installed. Simple butt joints were used for the shelves. Pine 10" wide was the stock here.

Although the 30" by 54" desk is extremely simple, it's sturdy and does everything a desk should. Two horizontal two-by-threes were nailed securely to the wall studs. Two legs, made of the same material, support the horizontals about two-thirds of the way out from the wall. Small angle brackets between the legs and horizontal members give the desk rigidity. The top consists of pine boards, covered with a sheet of wallboard.

A photo workbench was built in the same way, except that additional horizontal members were located midway on the legs to brace them and support a shelf. Here, however, the fiberboard top surface was omitted. Instead, the pine working surface was simply given two coats of a red rubber-base paint. Spilled photo chemicals wipe off without leaving a stain,

The same paint was applied directly to the existing concrete floor and to the top of the desk. On the floor, the result is a smooth surface that wears well and that cost only a fraction as much as an asphalt-tile or lineleum covering.

The walls and ceiling were given a coat of a peach tint water-base paint, the shelves were enameled white, and the table and bench legs, window frame, and footboard were stained with mahogany varnish.

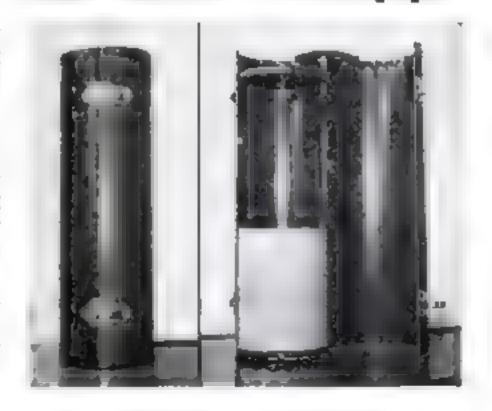
A door was built of pine boards, held together by three crosspieces, and then covered with a sheet of wallboard.

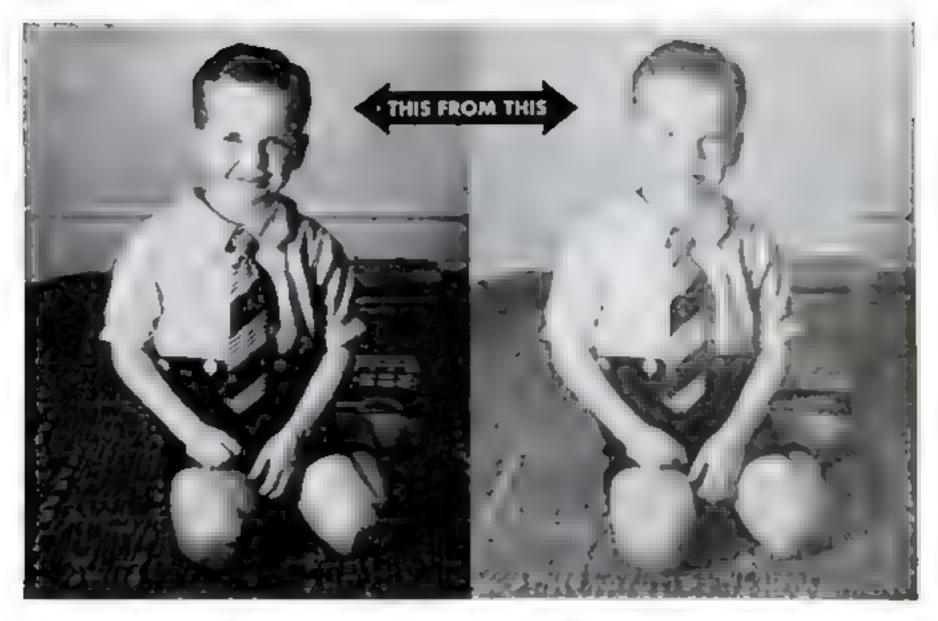
Movie Reels Carried in Case Made of Stovepipe

HERE's a handy carrying case for your movie reels. Made from 6" self-locking stovepipe, it stands 17%" high and accommodates 24 ordinary 200' reels.

After compressing the pipe until it just suited the 5%" diameter of the reels, I cut it lengthwise into halves. Then I hinged the parts together, drilling the metal and using rivets to attach the hinges. On the other joint, I installed two suitease catches, locating these to take care of the overlap.

Inside each end of one half I screwed a 5%" disk of %" plywood. A chain pushed through a piece of hose is fastened to one end as a handle.—Norman Maire, Beaver, Pa.





How to Revive Faded Photographs

PRINTS or negatives that have faded can be easily restored by bleaching and redeveloping. Fading results from the reaction of the silver image with hydrogen sulphide in the air or sulphur compounds in the emulsion.

First immerse the print in a formalin hardening bath for three minutes. Make this by adding % oz. of 37 percent formaldehyde and 78 grains of sodium carbonate to a quart of water.

After rinsing the print for five minutes, put it into a bleach made of two stock solutions. The first consists of 37 grains of potassium permanganate in 16 oz. of water.

The second is made by adding X fl. oz. concentrated sulphuric acid and 1% oz. table salt to 16 oz. of cold water.

For negatives mix equal parts of the solutions. Do likewise for prints, but dilute with 2 parts water. Immerse print until the image has almost disappeared.

Remove the brown stain by immersing the print in a 1 percent solution of sodium bisulphite. Then rinse thoroughly and redevelop in any nonstaming developer.

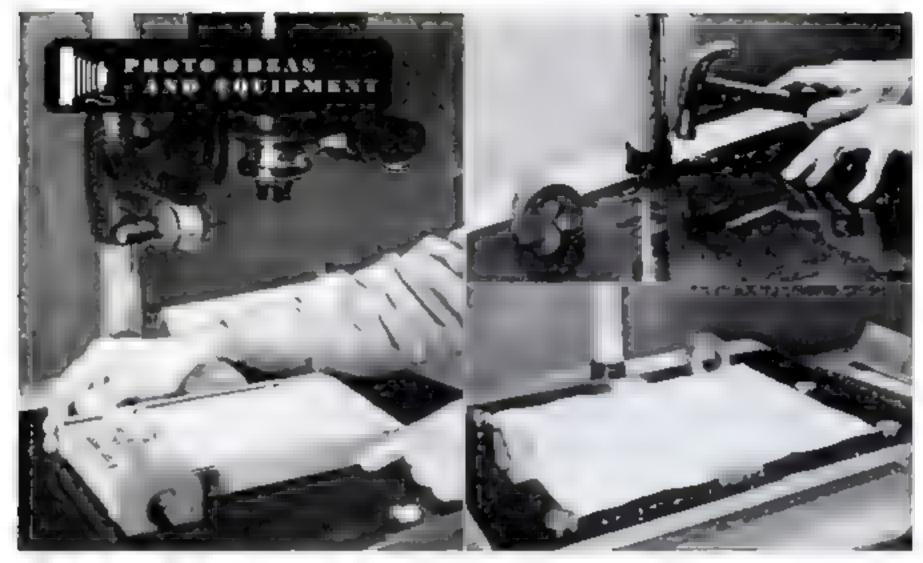
Do this under strong light. Then wash for 10 minutes and dry. No hypo is necessary.

If a negative or print is irreplaceable, it may be best to make a copy negative first.



Bleach the print after first hardening emulsion in a formalin bath. Leave the print in the bleaching solution until image has almost dis-

appeared (center). Then remove brown stain by immersing in sodium bisulphite solution, ruse well, and redevelop under strong light.



Magnets Hold Enlarging Paper. Two or more high-power permanent magnets and an old ferrotype plate will give you a smooth-working method of holding an easel of enlarging paper in place under an enlarger. Cut an iron ferrotype tin, or any other ferrous sheet metal, a bit smaller than the baseboard and tack it to the latter through predrilled holes. Wax and polish the metal and the faces of the magnets that will contact it.

An all-steel paper holder works best. If the holder is nonferrous material, fasten strips of steel along the edges. Several small magnets can also be used to hold large sheets directly on the steel base.

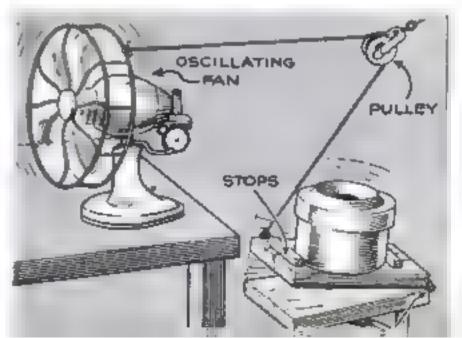
New Light Stand. Made of dural, the photographic light stand below weighs very little and collapses to a compact length. When fitted with a 4"-20 thread adapter, it also serves as an emergency camera support at low levels.

A product of the American Photographic Instrument Co., New York, it's made in four sizes—18", 20", 24", and 26" collapsed length. The 18" model extends to 7', weighs 25 oz., and sells for about \$12. Dimensions and prices of the others are in proportion.

You can make your darkroom light tight by covering small cracks or spaces around doors and windows with strips of roll-film backing paper. Cellulose tape or thumb tacks can be used to keep the strips in place over the cracks.—Sol Tepfer, Brooklyn, N. Y.

Fan Agitates Tank. Here's how I agitate the solution in my roll-film developing tank. The tank rests on a hinged platform. A string attached to one end of the platform runs through a pulley to an oscillating fan, which is fastened securely to its support.—John Brush, Gorham, Maine.







It Wasn't a Snapshot! Amateurs may simply raise a camera and shoot, but that's not how professionals work. For the photo at right (see page 110), PS Photographer W. W. Morris spent eight and a half hours assembling props, setting them up and arranging the lighting before he clicked the shutter. Above is a picture of the pic ture-taker taking the picture

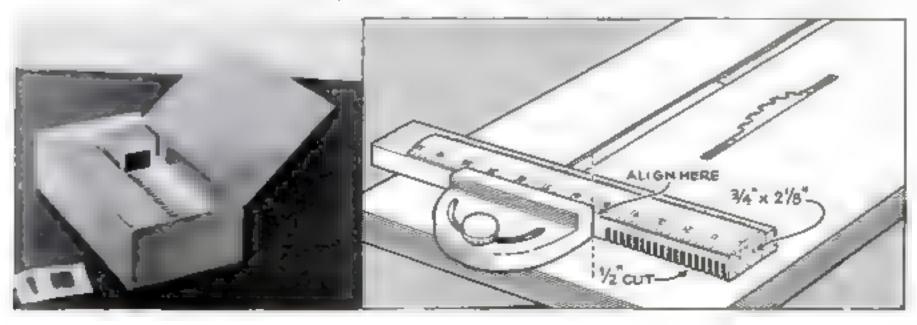
To give cross lighting, three No. 3 Wabash photoflash bulbs were placed in focusing reflectors atop the ladder at the far left. A G.E. No. 5 was located on the floor ahead of the camera and two G.E. 22s on the ladder at right. All lights were tied into a boost-

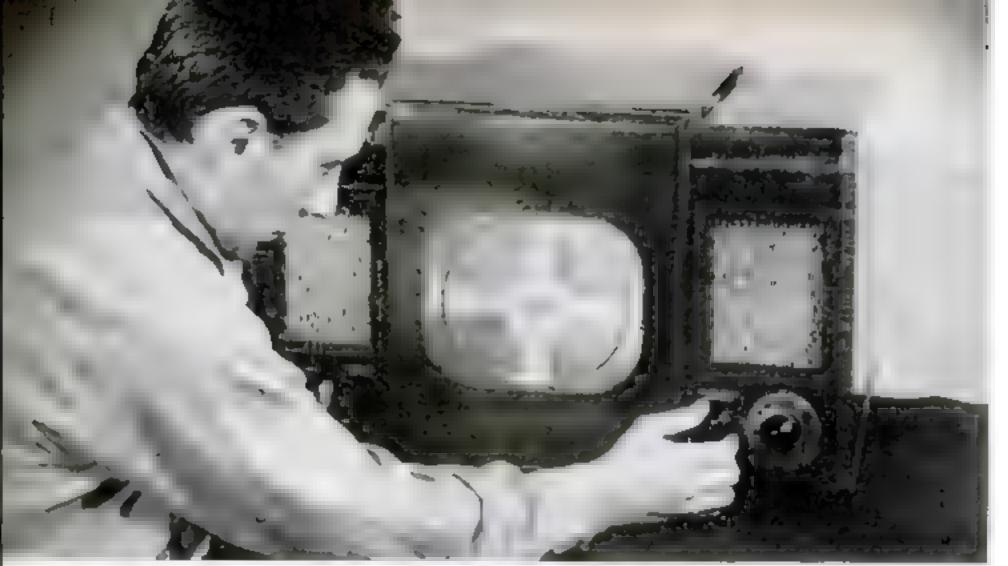
er box. From this a 45' lead ran to the photographer. The shot was made with open flash at f/22. Simultaneously, another photographer snapped the photographer,

Slides Stored in Cigar Box. From a cigar box 2%" or more in depth, you can make an excellent file for 2" by 2" slides, It will hold 65 to 70.

Make two holders from a strip of X" by

2%" hardwood, cutting each long enough to suit the box. Set the table saw for a %" cut and make the cuts %" apart. Sand the slots. Wedge a dividing strip 1" high between the holders.-Ralph S. Wilkes, Keuka Park, N. Y.





Fifty hours, from carton to cabinet, was the building time for this set.

I Assembled My Own TV Set from a Kit

You don't have to be an expert to wire up a television kit, but knowing a little about radio is a hig help.

By Robert Gorman

PS photos by Hubert Luckett

Like everybody, I had been hearing about TV kits. I've spoken to people who have built them and asked lots of questions. Adding up the answers, it seemed to me that one man's experience cancelled out another's. "Anyone can wire up a kit," said some. Others cautioned, "Don't try it unless you know some electrons by their first name."

"How are the instructions?" I asked. "They're a cinch," I was told, "if you're a graduate engineer with radar experience." But the other side also had its say: "The diagrams are clear. You can understand them even if you don't know the difference between a 1-meg, pot and a drip pan for grid leaks."

The only sure fact I had to go on was that in every case that came to my attention the kit builder was either an expert radioman, or he had an expert standing at his elbow.

I'm no expert. I've built a couple of simple receivers and phono amplifiers. I know how to read diagrams, and because I can count from one to eight I can distinguish the prong connections on a tube socket.

E assembled a TV kit. It works fine.

When I decided to try TV kit building, my first problem was to select the kit. Conceivably I could have made a study of the different types on the market, but a comparison of their fine points would have put a strain on my technical knowledge. I had heard good reports on the RCA 630 TS receiver—a 30-tube job—so arbitrarily 1 fixed on one of the lats embodying this circuit, There are several such kits, so I had to be arbitrary again. I picked the one that was then the lowest in price and had the most parts mounted. It's the RCA-type kit marketed by Lafayette-Concord Radio, a large mail-order supplier. Complete with all tubes including a 10" picture tube, it sold for \$195.50. A cabinet to house it is also available for \$42.50.



1. Here's the kit unpacked from its cartons. There are a lot of loose parts despite the fact that all the major ones are mounted.

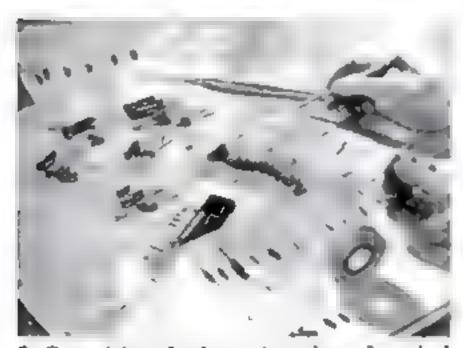


2. Emptying the envelopes shown at the left reveals this bewildering array. There are 108 resistors, 77 capacitors, and 11 coils

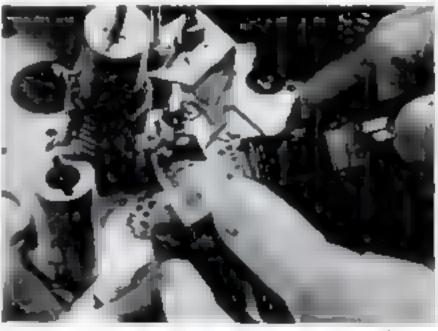
As I tumbled the parts and packages you see in photo I out of the shipping cartons I couldn't help feeling how nice it would be to forget the whole thing. That feeling didn't diminish when I unpacked the eight or ten envelopes and got a look at the hundreds of resistors, capacitors, and coils, plus miscellaneous wires, knobs, hardware, and many mysterious parts. There's no organiza-

tion of the components—they're all there, but separating the pieces and relating them to the circuit is the builder's job

The instructions that are provided also give a minimum of orientation. You get an RCA service manual and a couple of mimeographed sheets of parts lists, color-code information, and instructions for connecting the prewired tuner section. Most



 Organizing the items is a chore. I marked the value of each one on the diagram and taped the parts down in order on separate sheets.

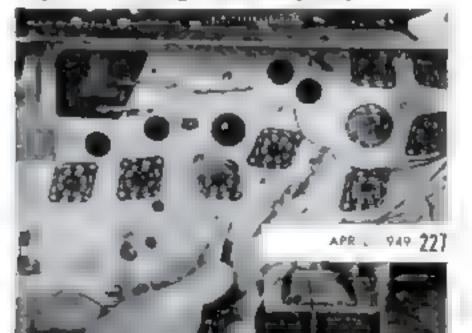


4. Removing the tubes usn't necessary, but I thought it was safer. In the tuner each must be marked for return to the identical socket.

5. Chassis layouts in the service manual give much useful information, including the function and location of each of the 30 tubes.

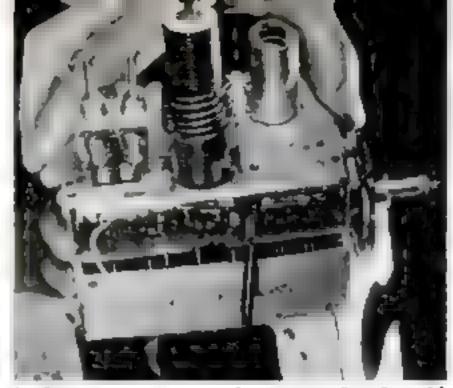
6. As an aid in wiring, I marked the parts on the underside of the chassis as well. It was helpful in locating terminals quickly.



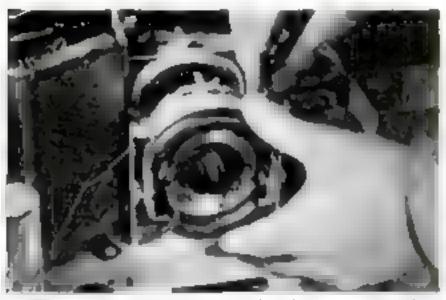




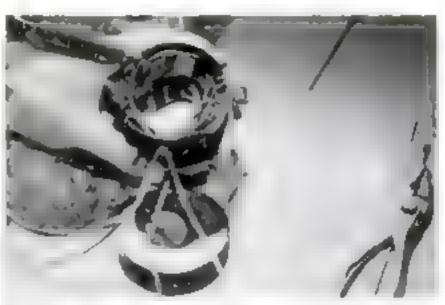
7. Speakers are fragile. This one has four leads which can be soldered in at the very end. I removed it for safety during the main job.



8. Do not remove is what it says, but I could not complete the wiring in this crowded corner without first unbolting the tuner.



9. The deflection yoke is held in a U-bracket by two wing holts. They have to be taken out to complete internal wiring on the yoke.



10. Two resistors, a condenser, and four wires are soldered into the back of the yoke. Details are furnished in a corner of the diagram.

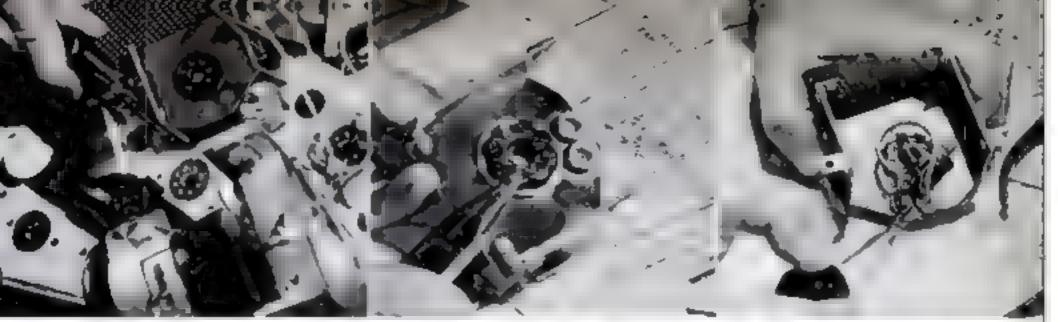
important, there are six full-size pictorial diagrams showing the mounted parts in black and the wiring overprinted in red. Each of these sheets has a different set of connections, broken down for wiring convenience. Because of their size and the red overprinting, they are easy to read and follow. The RCA book has a good deal of

11. As a precaution against burning out the high-voltage transformer should one tube go bad, I wired in a No. 47 pdot light as a fuse.



additional information. I found a couple of minor changes from the RCA diagram; there are also one or two errors that had been corrected in pencil on the sheets.

By way of getting started, my first step was to arrange the small components according to wiring sheets. The experienced man may scoff at my system, but I found it helpful. I went through each diagram and the parts lists, marking the value of each part next to the code number printed in red. At the same time I picked out that part and taped it to a sheet of plain paper, marking the code number alongside it (photo 3). By first separating the resistors into piles according to the first band of color, I was able to pick out the proper one fairly quickly For example, if I was looking for a 6,800-ohm resistor, I had only to glance through the pile containing those with blue bands, meanwhile looking for a gray second band, and so on. With the parts taped to sheets. I didn't have to hunt for a single piece while doing the actual wiring.



12. The high-voltage rectifier is placed on an insulated platform inside a shielded compartment. Remove the platform to were the socket.

13. Corona—a kind of electron halo that occurs at high voltages—is minimized by removing the unused rectifier-socket prongs. One twist and they drop out.

14. After mounting the parts and soldering in the corona ring, I dabbed the terminals with cellulose cement for extra insulation.

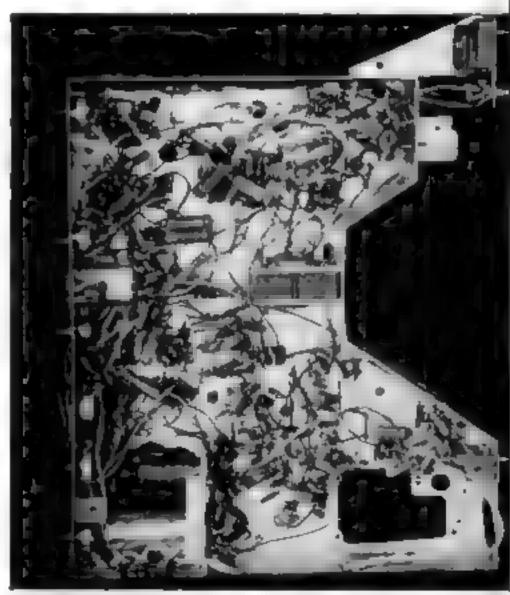
To minimize the risk of breakage in handling the cumbersome chassis, I removed all the tubes. A band of transparent tape over the number on the glass insured against it rubbing off in handling. The front end or tuner section, which comes completely wired and aligned, uses three 6]6 miniatures. It's essential that each tube be restored to its original socket. Photos 4 and 5 show how I marked each tube and socket with precise identification.

With these preliminary details attended to, I just had to buckle down to the serious business of wiring the chassis and soldering in a couple of hundred loose pieces. On this subject, too, I had heard all sorts of conflicting reports. The best time estimate I got was eight hours, but most of the people who quoted this figure had it at second hand. Rehably and at first hand I got approximately this time from two people—both experts who had wired a number of kits. One of them had a helper read off the diagrams while he worked.

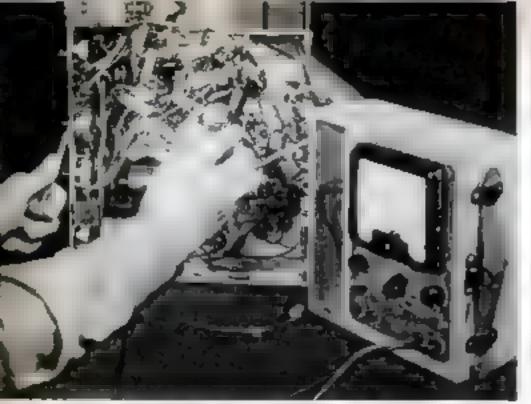
However fast others may be, I have to report that my wiring time exceeded four times the estimated eight hours. I'll tip my hat twice to anyone who builds his first kit, alone, between sump and sump. There are about 400 pigtail leads to solder on the loose components alone, and another couple of hundred on the wiring and ground connections. Going strictly by the book, I tried clinching every lead before soldering it. That makes a big difference in time—the fast radiomen I spoke to didn't clinch the wires; they merely pasted them to the lugs with solder.

Incidentally, most of the lugs to which connections are made in the early sheets get additional leads in the later ones. On tube sockets it is therefore advisable to make

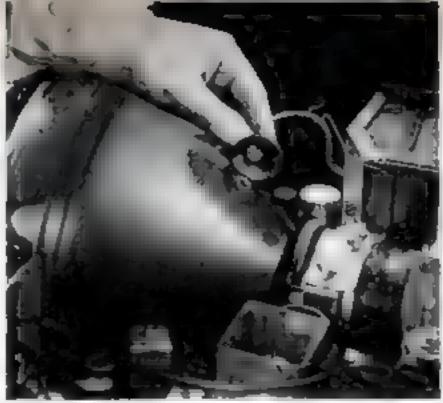
the initial connections to the lower of the two holes, saving the top one in case another wire has to be brought to it. It's also important to keep leads as short as possible in any high-frequency radio work. I aimed at this but didn't succeed too well, as you can see in the close-up photos of my chassis. While we're on the subject of soldering, remember that rosin flux is conductive at high frequencies. If you decide to build a TV kit, use as little rosin as you can get away with and wash off any excess with alcohol. Rosin-core solder is okay; it eases the work



15. Wiring took a long time and was a tedious job. Professionals will scoff at these long leads. They should have been kept shorter.



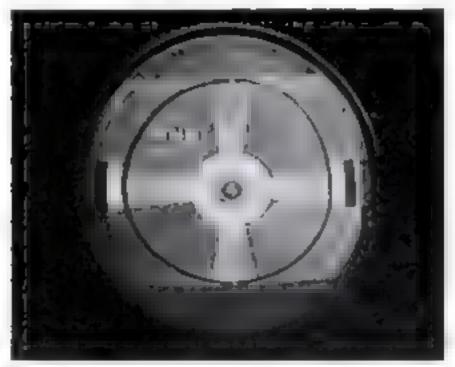
16. Checking for shorts is an important precaution. Test from B-plus to ground, AC to B-plus, and from both AC leads to ground.



17. Danger! 9 000 volts of it! The anode cap is the hot spot on top of the chassis. It holds a charge long after the power is turned off.



18. The ion trap on the neck of the tube is adjusted for brightness. Six ther controls at the back are also set to get the best picture.



19. Success! A lot of work and worry went into assembling this kit, but that clear, sharp test pattern made it all seem worth while.

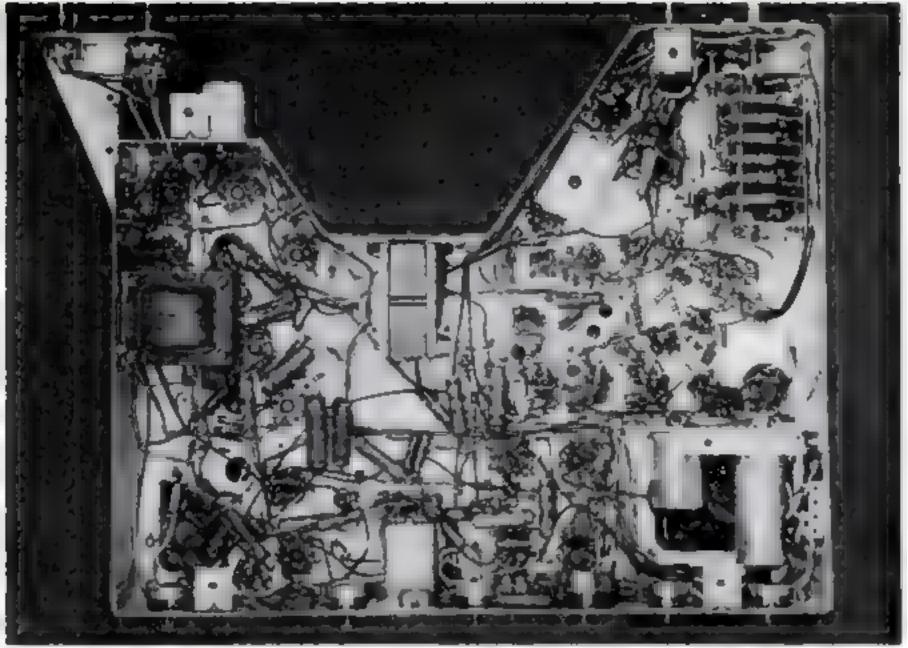
and doesn't contain enough paste to do much harm. No shielded wire is needed in the hookup. I started with a full-size 100-watt soldering iron. Along about the middle, as the chassis started to crowd up, I switched to a pencil-size iron and used it almost exclusively in the tight corners.

The deflection yoke through which the neck of the picture tube passes has to be removed from the top of the chassis. Two wing bolts are all that hold it. The back, which is a cardboard cover, slips off so that two resistors, a condenser, and four wires may be soldered in.

Discussing the construction of this kit with some men who know it well, I picked up a couple of tips that may be worth passing along. Servicemen have encountered some trouble with sets and kits of this type because the 6BC6-G horizontal-sweep output tube sometimes becomes defective and starts to draw excessive current. Since the

plate of the tube is in series with one winding of the high-voltage transformer, the extra current also flows through the transformer. In most cases this results in a burnt-out transformer—and an expensive repair job. To reduce this hazard, I inserted a No. 47 pilot light in series with the transformer lead to act as a fuse. Photo 11 shows how I attached the bracket beneath the chassis. The lead from terminal 1 on the transformer to pin 6 (a dummy pin) on the 6K8-GT horizontal sweep oscillator is opened and the lamp wired in. Excess current burns out the bulb

Another useful trick-although less generally known and applied-concerns the mounting of the 1B3/8016 high-voltage rectifier. This tube puts out better than 9,000 volts. As a result, the socket connections around the base are subject to a high-voltage discharge known as "corona." One method of minimizing corona is to remove



20. This isn't my set. I wish it were, not because it works better than mine but because I'd be proud of the wiring. It was assembled by

Melvin Pollack, Lafayette's chief service engineer. Note short, neatly dressed leads and compact arrangement of small parts.

the extra lugs from the bottom of the tube socket. Only three of them are needed, so the others can be twisted slightly and pushed out through the top of the socket (photo 13). The necessary parts and wires are then soldered in, and the corona ring is sweated into the two anchor points on the mounting plate. Excess solder and rosin is scraped out and the anchor lugs are coated with cellulose cement.

When I finally finished the wiring I had to agree with the most enthusiastic kit builders. It's not hard. It was, for me, a long and tiring job, but it's certainly possible for a semiskilled experimenter to get it done.

After checking the wiring carefully, I made a couple of safety tests before plugging in the set. To check for shorts you need an ohometer (photo 16) or a continuity tester. The main points to test are B-plus shorts (touching one meter prod to the chassis and the other to two or three electrolytic-capacitor terminals), shorts from AC to ground, and from AC to B-plus. If you get no reading at these points, it is reasonably safe to plug in the set. It may not work, but the chances are that no serious trouble will result.

Handling the picture tube calls for spe-

cial precautions. Hold it only by the large bulb, never by the neck, and don't try to move the set while the tube is in. When using the tube out of a cabinet, prop a medium-size book under the face end to support the weight (in a cabinet it is held by cushioned brackets). When the set is turned right side up and all the shields are in place, the main danger spot is the second anode cap (photo 17). There's over 9,000 volts there, so keep clear of it if you value your health. Make sure the power is off when handling the cap—but even that isn't enough. The high-voltage capacitors store a charge and can give you a jolt long after the switch is turned off. After removing the cap from the tube, hold it a half inch from some piece of grounded metal to draw a spark if any energy remains. Bring it closer until it touches the metal. Make sure that the cap is either in the tube or clear of any possible ground when the power is on

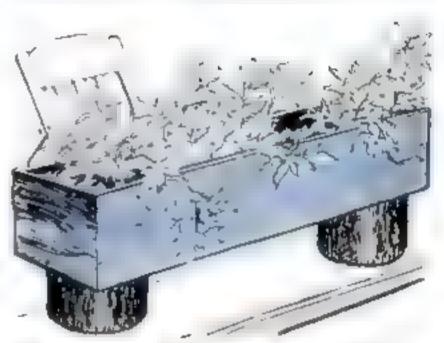
The ion trap, being adjusted in photo 18, and the six controls along the rear edge of the chassis must be set for the best image. Once they are tuned for your antenna and location, nothing has to be done to them. All further tuning is done by the seven controls in front.



If a paint can has no handle, place it in a child's sand bucket, It will be much easier to carry up a ladder. You can also fit a hook to the handle of the pail for hanging it



Birdhouses can be fastened to the top of a pole with a large tin can. Screw the house to the bottom of the can, shp the can on the top of the pole, and nail it in place



To prevent rotting of purch railings by flower boxes, set them on two sections of a small log. Out the sections about 8" long, selecting pieces that are nicely covered with bark.



An old 5-gal. oil can is quickly converted to a no-stoop catch pan for the garden. Cut one end off diagonally with tin snips and fasten a handle to the other end with bolts.



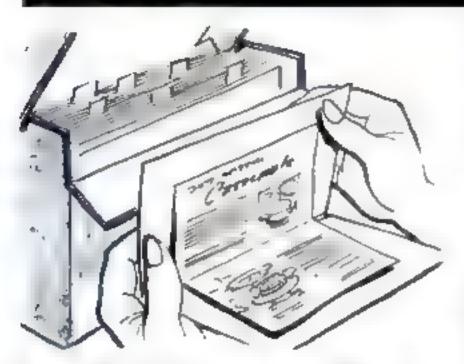
Save wood shavings and scraps from your workshop in paper bags. Tie the necks tightly. Then, to build a fire in a stove or fireplace, just use one of these bags as kindling.



Bending inward the ends of standard wire coat langers will convert them to holders for children's garments with suspender tops, such as sun suits, suspender skirts, or overalls.



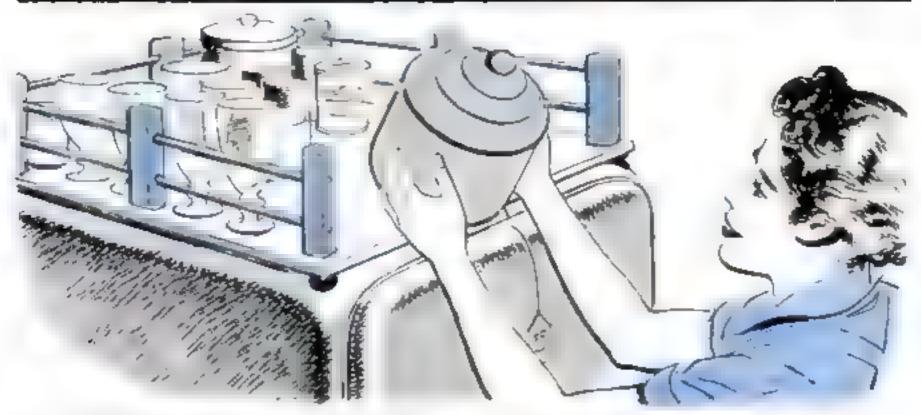
When the nuterial between the holes of a plastic button gives way, you can repair it by piercing two new holes with a heated needle. This is handy when you can't replace a color.



Two 3" by 5" file eneds, honged with cellulose tape, form a neat folder for recipes clipped from magazines and newspapers. Paste the recipe to the cards and fold them together.



House plants that don't get much similable can be helped by turning a similarity on them for a little while each day. Don't place the lamp too close to them or leave it on too long.



The partially rounded tops of most refrigerators make them unsatisfactory for storage. A

plywood sheet, held by suction cups and fenced with dowels, gives you a handy flat surface,



Machines Shape Moldings Quickly

By Edwin M. Love

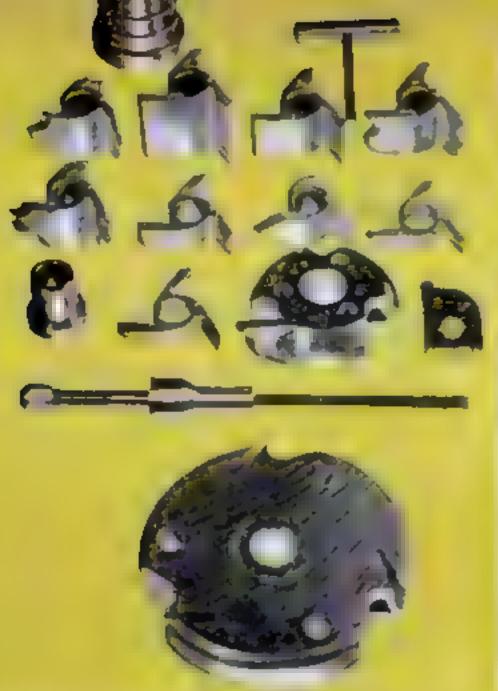
THERE'S a lot of satisfaction in making moldings by hand, and such trim lends an authentic touch to the reproduction of period furniture. But granting this, don't overlook the advantage of machine work A spindle shaper takes the place of experience. If you can push and pull, you can make a thousand varieties of molding with this tool, ornamenting straight edges, enriching circular table tops, and profiling all manner of scroll-sawed curves. Not only can all this be done at a gallop, but the precision of the finished job is incredible to those who aren't familiar with the shaper.

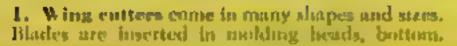
Though the shaper is specially adapted for molding, other power tools will also do

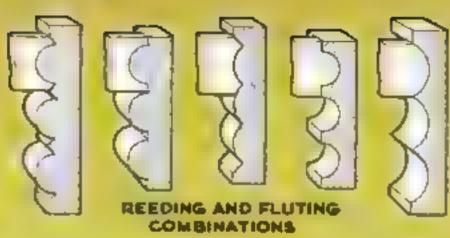
the job. The drill press, for example, is just as effective if not quite as fast. You can also ship a special head on your circular saw to mold straight or convex edges, and you can shape modern stepped edges with a jointer. Add a little ingenuity to almost any power tool and you can do at least part of the work

A shaper equipped with cutters similar to those illustrated in Fig. 1 gives a choice of several sizes of beads, flutes, quarter-rounds, and coves. These can be cut singly or in combinations, as pictured in Fig. 2. If you have had experience in jointing and rabbeting on a shaper, you'll have no trouble with moldings, since the adjustments of table and fence are essentially the same.

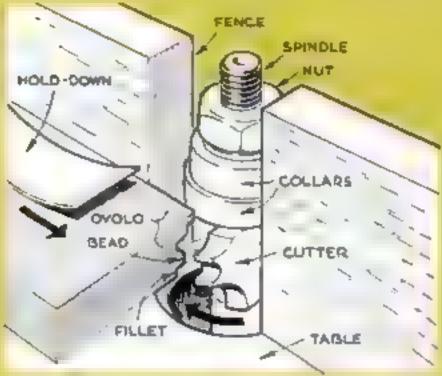
The molding being made in Fig. 3 has a







2. Bends, flutes, quarter and half rounds can be cut singly or in combinations like these.



keep the cutters below the work for greater safety. The uncut edge bears on the fence.

small portion of the edge left unshaped. This straight part guides against the fence, which is set with both sections in alignment. Mount the selected cutter on the spindle, using collars beneath it if necessary to raise it to the correct height.

Whenever possible, orient the work and the cutters so that the face bears on the table as in the left-hand sketch of Fig. 4. This puts most of the cutter out of the way of your fingers and assures a uniform depth even if there is some variation in the thickness of the wood. If the shaper isn't reversible, you may sometimes have to cut on the upper face of the piece. Use a small collar that won't project beyond the cutting parts of the blade and, especially on narrow work, use hold-downs and other safety devices.

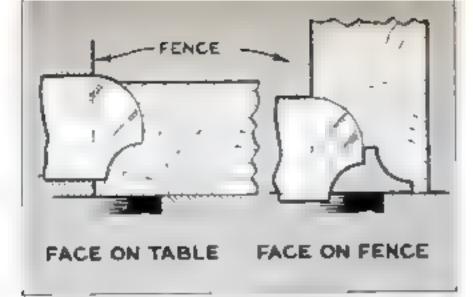
Make test cuts on scrap before running the mold. Hold the work firmly against fence and table and feed it smoothly past the cutter. Some combinations of cuts require the face of the piece to slide against the fence while the edge rests on the table, as in the right-hand drawing, Fig. 4.

Moldings made by combinations of cuts

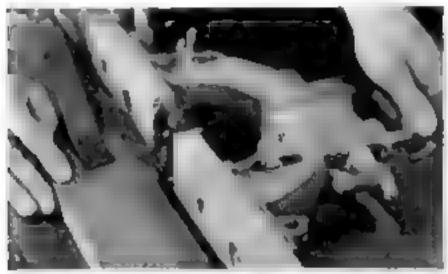
need separate setups for each stage, which is treated as a new molding. Change the cutter if necessary and reset the fence and hold-downs. Where a molding is made on one face and duplicated on the other, turn the board over and use the same setting before changing it.

Molding an entire edge is similar to jointing. The fence on the outfeed side has to be set forward enough to support the edge as it comes past the cutters. To find the setting, start the cut and move the fence section into contact with the molded part as in Fig. 5.

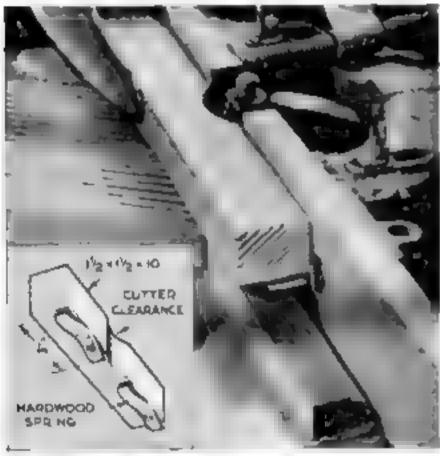
Applied moldings that are attached around the edges of cabinet tops, panels, and similar units can be narrow strips. They are most easily made by shaping the edges of boards and ripping them off afterward. This procedure, however, may be too expensive for valuable woods. To conserve costly stock, and also as a means of salvaging waste rippings, it pays to make a jig of the type shown in Fig. 6. The jig is a wooden bar (inset) hollowed to give cutter clearance. A couple of scroll-sawed wooden springs are fastened to the underside. The



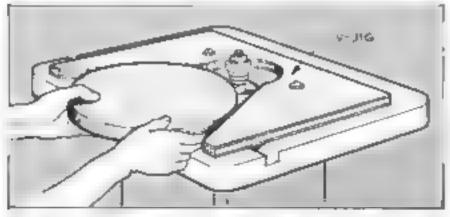
4. Slide the face on the table whenever possible, against fence only for special cuts, above.



5. In shaping an entire edge, set the outfeed fence forward to support the molded portion.



A molding jig enables you to salvage waste rippings or shape thin strips of costly wood.



7. Circular stock is easily shaped with a Vor pivot jig. Reset the jig for each setback,

bar is clamped to the fence where it will bear firmly on the top of the strip. If the fence is offset for a full molding, place a shim between the jig and the infeed section when clamping the bar. A kerfed wooden spring clamped to the table holds the strip against the fence. Push the work in at one end and pull it out at the other. You can use the same jig to groove or rabbet strips before molding them.

Circles are as easy to shape as straight edges if a pivot or a V-jig (Fig. 7) is used. It's necessary to reset the fig when making stepped-back moldings or those requiring two or three passes. When molding the full edge all around a disk with a V-jig, mark the starting point so you can stop feeding the work exactly at the end of one

revolution.

A tilt table for mitering and molding beveled edges is illustrated in Fig. 8 and a simplified version is detailed in Fig. 9. With both of these, the fence sections can be clamped at the proper angle for any molding. Attach the table with the regular

frame studs or with a C-clamp.

Figure 10 shows a molding being made on a drill press. The process is identical with shaper practice except that the spindle is above the work. An auxiliary table is a convenience. For a fence, clamp a strip of wood in place. The usual cutters for drillpress shaping are small three-winged ones with 5/16'' holes, similar to the larger types. Built-up heads into which blades can be inserted are also available. Use special adapters rather than the usual drill chuck for the cutters.

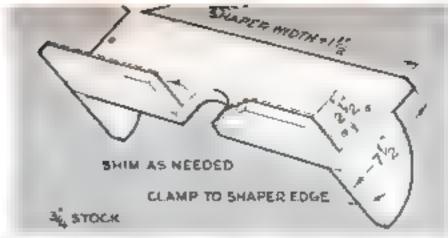
You can use a molding head on a shaper, too. One suitable type is pictured at the bottom of Fig. 1. Blades to be inserted can be purchased in a variety of patterns, usually at lower cost than an equal assortment of wing cutters. With a molding head, too, the larger diameter of sweep allows deeper setbacks on shaped edges.

Molding heads for circular saws resemble the smaller shaper variety and use the same blades. If your saw fence is not arched for use with a molder, screw or clamp to the saw fence a flat board, arched to suit (Fig. Place the work face down on the table or slide it on edge, according to the molding desired. To insure uniform contact of the cutter and curved work, make a pencil mark on the fence or table at the center of the arch. Expose only as much of the cutter as is needed for making the molding.

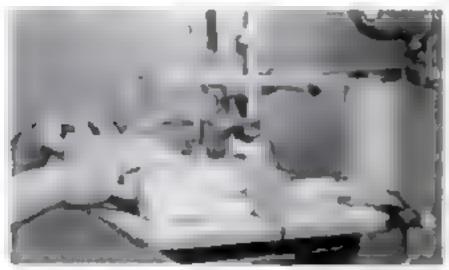
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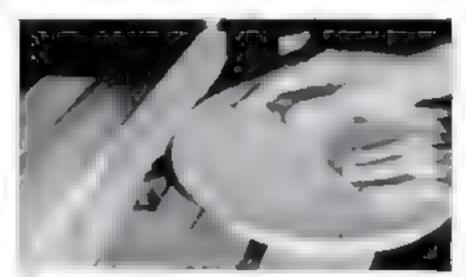
8. A tilt table made to fit your shaper is an aid in mitering or in molding a beveled edge.



9. A simplified version of the table at left can be made according to these specifications.



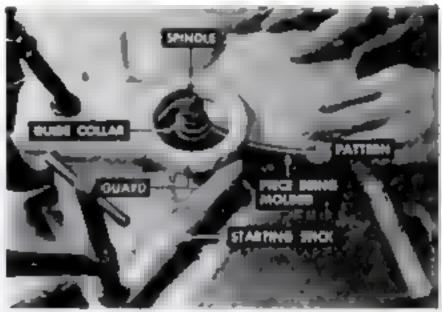
10. Molding on a drill press is the same as on a shaper except that the spindle is above.



11. Special heads enable you to use a circular saw for shaping any straight or convex edge.



12. For freehand work the shaper has no peer. Collars of the right diameter guide the edge.

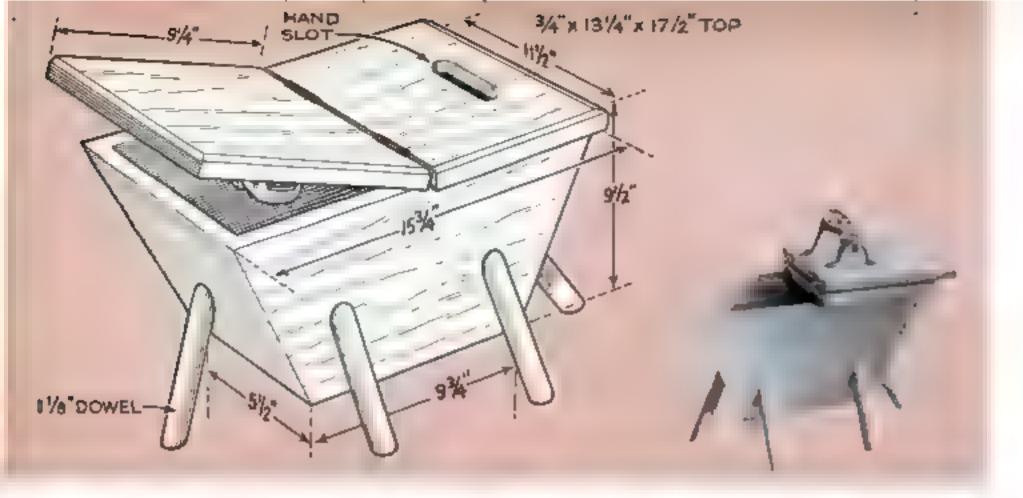


13. To mold an entire edge, tack a pattern to the workpiece so it will bear on the collar,

It is in freehand molding of irregular edges that the special capabilities of the spindle shaper are exhibited. Cutting a uniform molding requires that the edge of the work be kept at a constant distance from the center of the spindle. With the shaper this is accomplished by mounting a collar of proper diameter above or below the cutter. Revolving with the cutter, the collar bears against the work, keeping the work-to-spindle distance uniform. The transfer is so accurate that any bump or groove in the sawed edge of the wood will be repeated in the molding, so you'll want to be sure that it has a true edge to start with.

Starting is the critical point in freehand shaping, but grabbing of the cutter can be prevented by feeding the work gradually into the blades. Most shapers are provided with tapered pins to be inserted in holes on the feed side of the spindle. Press the edge of the piece against the pin as in Fig. 12, and pivot it slowly toward the blades. Where possible, start the cut with the grain. Once the molding has reached full depth, swing the piece away from the pin.

To use the collar effectively, it must have some wood to bear against. Where the entire edge is to be molded, tack on an accurate pattern as shown in Fig. 13. Because the collar guides the pattern, the piece to be shaped can be an oversized, roughly cut scrap. In the same picture note the plywood guard shimmed up at such height that it serves also as a hold-down. The guard interferes with the starting pin, so a pointed stick is clamped to the table to substitute for the pin.



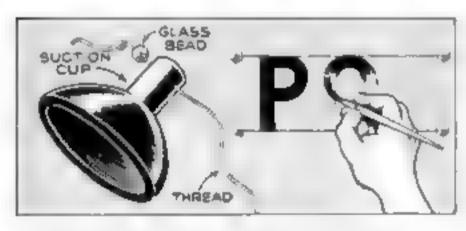
Footstool Combines Shine Box

Patterner after the handiwork of the Pennsylvania Dutch, this shoeshine box doubles as a footstool. Although the one pictured above is undecorated, its simple lines adapt it to stenciled designs taken from Pennsylvania Dutch furniture. (PS, May '46, p. 116.)

The bottom and top are cut from \$" plywood and the sides from \$" stock. There

are a couple of ways to assemble the box. I mitered the edges of the four sides, laid them edge to edge, and applied cellulose tape as hinges after smearing glue on the mitered edges. Folded into box shape, the sides were held by the tape until the glue had set. Afterward, I removed the tape and strengthened the sides with brads. An alternate method would be to miter and spline the sides. The legs are held by screws.—

S. Manville, Manhattan, N. Y.



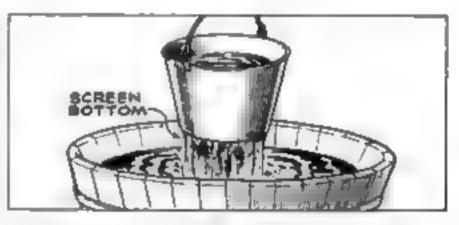
Thread Forms Guide Lines

When painting signs on glass, I hit on this method of laying out true guide lines. Using four small suction cups, I strong stout thread between each pair. The thread, pushed through holes in the handles of the cups, was tied to a bead. These lines stay put and are always straight and parallel, provided the cups are equally spaced on each side.—Charles Mills, Millington, Mich.



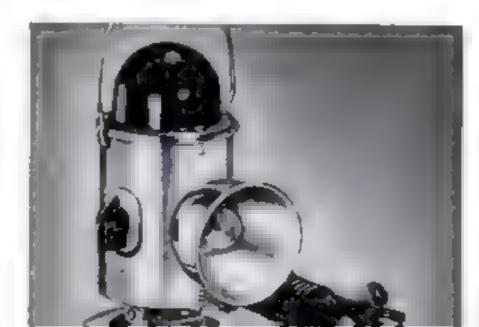
THE Pro-Tex-U-Lite®, made by Weiser-Hill Mfg. Co., Canton, Ohio, gives motorists five lighting combinations: red flasher and trouble light, steady red light and trouble light, trouble hight alone, red flasher alone, and steady red light alone.

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Bucket and Tub Wash Sand

I had a quantity of sand to screen but found the going tough because the sand was damp. To speed up the operation, I cut the bottom out of an old bucket and fitted a sieve in its place. Then I shoveled sand in the bucket and dunked it up and down in a tub of water. The sand went into the tub and I shoveled it out.—Arthur Kencille, Felton, Calif.





Lighters Show Fuel Supply

Two eigarette lighters with clear plastic fuel reservoirs are now on the market. Each sells for about \$5.

At left is the Ritepoint Liter , made by the Ritepoint Co., St. Louis, Mo. It is available in four different colors. The fuel supply is transferred to the wick as needed by a finger-touch valve. The one at the right is manufactured by the Video Lighter Corp., Chicago, It's said to give 4,000 lights with one fueling. The gift box in which it comes serves as a cigarette container.

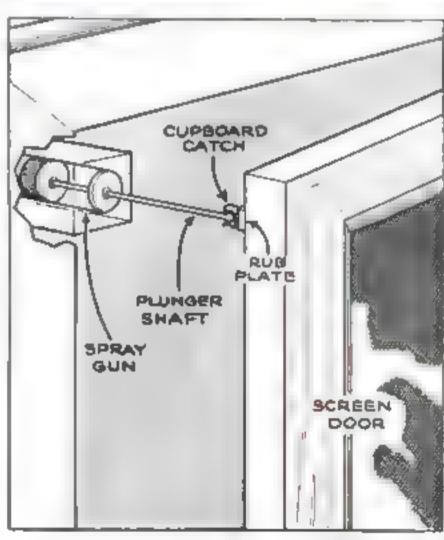
Compressed Air Stirs Paint

OLD paint that has become thick and lumpy can be renewed with the aid of a small air compressor and a copper tube that pipes the air to the bottom of the paint can. Add some thinner to dissolve the lumps, and force air through for five to ten minutes. There will be little mess to clean up if the pressure is controlled so that the paint doesn't bubble too violently.—Leonard O. Timm, Bennington, Neb.

Spray Gun Cheeks Screen Door

SCHAP parts and an old insect spray gun went into this compressed-air doorcheck for a screen door. When the door strikes the protruding arm, the air gradually leaks out around the plunger, allowing the door to ease into place. Remove the solder holding the nozzle and cap on the cylinder with a small alcohol torch. Hacksaw the cylinder so its length is about 1%" less than the distance between the inner and screen doors. This allows for mounting in a X" plywood box inside the door frame. Solder the cap back in place and close the vent hole with solder. Push the plunger as far forward as it'll go and saw it off "" from the end of the cylinder. To pull the plunger out when the door was opened, I mounted a cupboard catch on the screen door. It grabs the plunger, draws it out, and lets go.-Gene L. Henderson, San Ysidro, Calif.







Square or reef knot. It's one overhand knot with another overhand tied on top the first but in the opposite way.



Two bulf latches. Use this one for mooring a boat or for tying up a bulky bundle such as a mattress



Hackamore tie. Holds well, but a yank on the free end automatically unties this one. You'll had lots of uses for it.

Knot It Right

By Roland Cueva

SIX simple knots, pictured here, are like half a dozen extra hands. You'll find them useful at home, in the shop, and on camping trips. They're easy to tie and untie. Used in the right spots, they'll speed up such commonplace jobs as tying a package, attaching a towline, or joining two ropes.

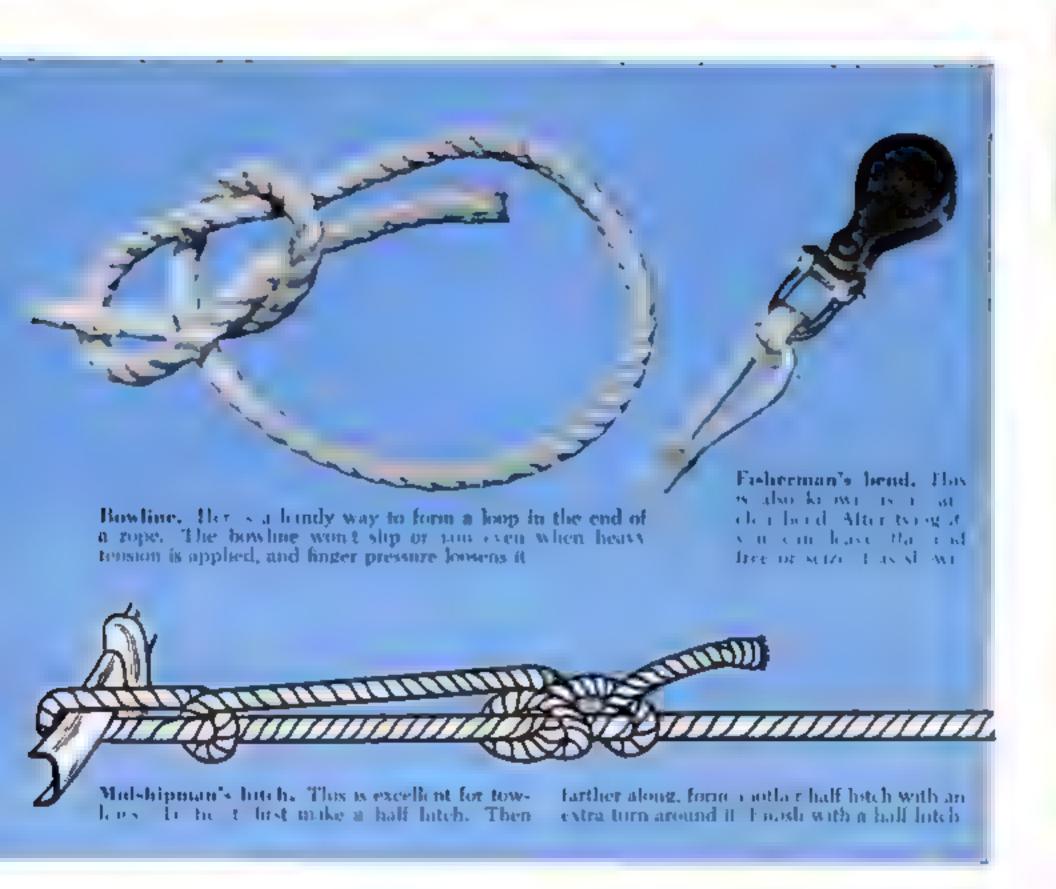
One of the oldest knots is the square or reef. Use it in joining two ropes of the same diameter, in tying bundles, bandages, and the reef points in sails. This knot was known in ancient Rome and Greece. Reproductions of it are found as ornamentation on carvings.

The square knot is two simple overhand knots, the second one tied in the opposite

manner from the first. When tied on many packages — and always on shoelaces — the ends are doubled in the second knot to form a bow. The surgeon's knot is similar to the square except that a double overhand knot —two turns—is tied first and then the second overhand knot is made in the opposite direction.

Just below the square knot, in the above photos, are two half hitches. This useful knot serves many purposes, since it can be quickly tied and untied. Use it to moor a boat or to tie up a bulky object such as a mattress. You can also secure a towline with it, but the midshipman's hitch makes a better knot for this purpose.

Still easier to untie, but equally secure, is the hackamore tie-shown here looped over



a miniature anchor. Commonly used to tie a horse, this knot won't slip but a pull on the free end automatically undoes it. Among other things, you can use this knot to tie up plants, bushes, and tree limbs, or to put up a temporary clothesline. It also makes a convenient emergency lashing to hold a gate or door open or closed. In this case, the fixed end of the rope is secured by two half hitches to a ring, bolt, or other projection on the jamb or gatepost. The big loop goes over the doorknob or gate.

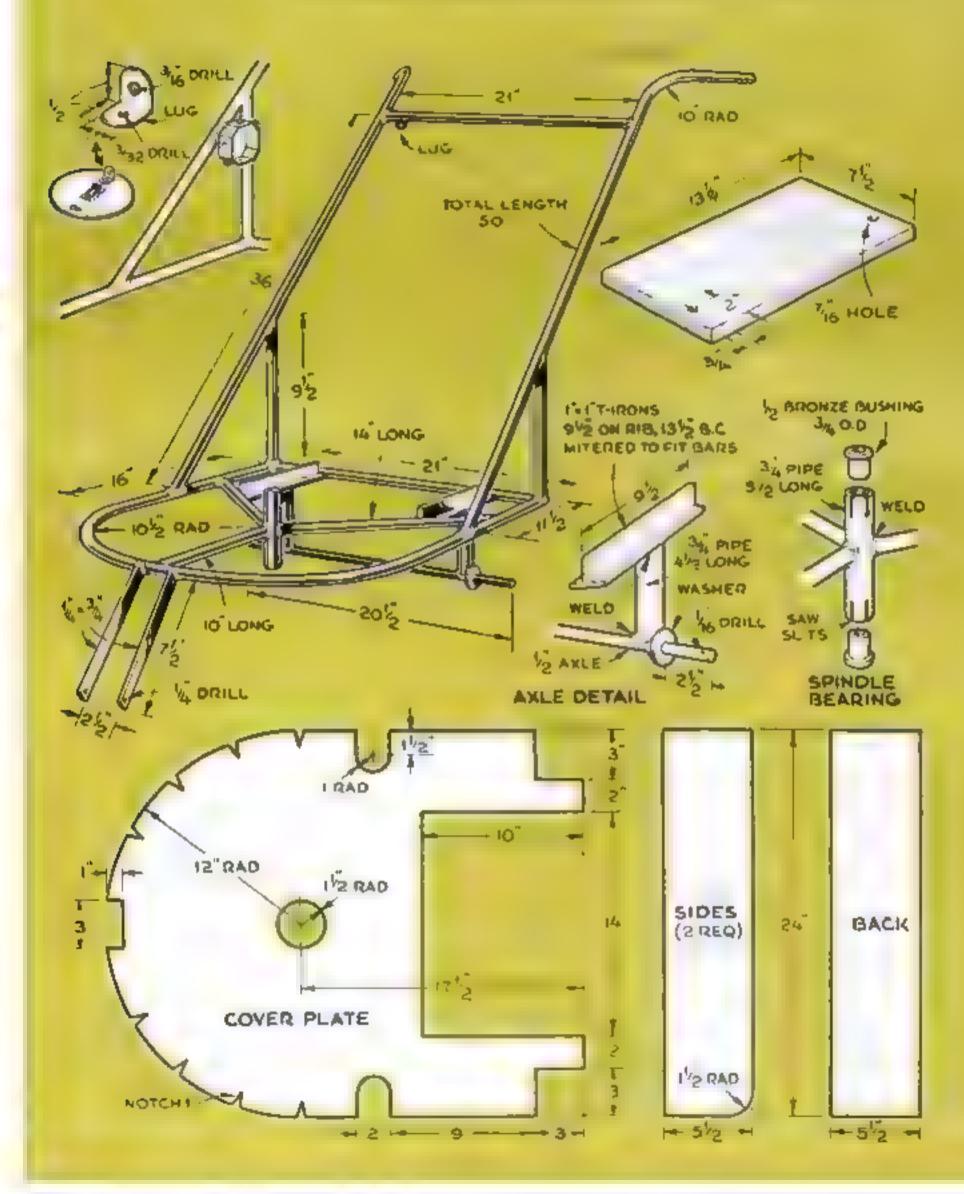
An emergency handle for a bundle, box, or suitcase can be fashioned speedily with a bowline—the large knot shown at the top of this page. This old sailor's knot is one of the quickest ways to form a loop in the end of a rope. Its construction is simple but it never jams or shps and can be easily untied. Construction gangs, riggers, and dock workers use this knot extensively. It's good for hauling, mooring, or any other job where a sure fastening to a solid object is required.

When you use a block and tackle to hoist a heavy object, tie a bowline around it. This knot also can be used as a foothold in a rope when working on a tree, wall, or the side of a building. If you have to throw a line to a swimmer who's in trouble, tie a large bowline in the throwing end. It won't slip and it gives the swimmer a good, big loop to grab. You can also make an emergency dog leash with the bowline, using the bowline on the hand end of the leash.

To secure a fishhook to a line or a leader to a line, tie the fisherman's bend. This also is known as the anchor bend since it's used on anchors or for mooring to a ringbolt. The end may be left free or seized as shown. There are other versions of this bend.

The midshipman's hitch is your best bet for towlines, or in any situation where you'll want to quickly lengthen or shorten a rope—as on a tent stake. To slacken the tension, slide the knot toward the stake. To tighten it, move the hitch away from the stake.

No clatter, no sweat, no cussing when the grass needs cutting. Here's a gadget that puts power to work on your laws while you lost slong behind.





By Evan Wright

NO MATTER how you cut it, mowing a lawn is still work. The best you can do is to put machinery to work instead of your muscles. That's what this low-cost power mower does. I've built three like the one pictured above. The total cost of this model—exclusive of the motor—was about \$15. An old washing machine furnished the motor.

I are-welded the frame of \$" black pipe, but gas welding or brazing could be used. If you don't have welding facilities, bend up the frame and take the parts to a shop.

Draw full-size patterns of each piece to be bent. Then make a hickey from a 5' section of X" pipe with a tee on one end. The handle bars are bent as shown in the photo on the next page. Start bending the frame with the tee in the center of the arc and bend one half. Return to the center and bend the other half.

Begin with the outer pipe of the bed-a 65" length. Bend it to a half circle with a 10h" radius. The two straight sides are 16" long. Then cut the 21" rear crosspiece and weld it in place. Make the spindle bearing next. After cutting it to the length shown in the drawing, make two 1%" saw cuts at right angles in each end. Place shouldered bronze bushings, %" i.d. and %" o.d., inside the slit ends. Then compress the ends of the pipe in a pipe vise to a tight fit. Weld the saw slits and, while the pipe is still red hot from the welding, drop it in cold water. This shrinks the iron tightly around the bushings. Drill a %" hole through the pipe and the top bushing and into the oil grooves for lubrication purposes. The lower bearing is oiled by drip from the top one.

Cut the three radius bars as indicated. Miter the 14" ones to fit the sides of the frame. With the spindle bearing in place,



Frame and handle bars are bent of %" black a pipe. To do the bending, make a hickey 5' king of X" pipe with a tee on one end.



Cutter assembly includes 13" square iron plate, spindle, pulley, and collar. Blades are replaceable type used on farm mowers.



Position motor on mounting board at an angle. This centers the motor's weight. Mounting hoard may be moved back to tighten belt.

block the frame up square and weld it. Next cut the two 1" by 1" T-irons. Miter them for a close fit to the rear radius bars with 13%" between centers and weld them.

Now turn the bed over and weld the two 4%" legs to the T-irons. Weld a %" cold-rolled steel axle to the legs. To provide a flat bearing surface for the 8" wheels, slip a big washer over each end of the axle and weld them to the legs. Drill 1/16" holes in the axle ends for cotter pins. Make the front fork next. It's dimensioned for a 4" wheel. Put the wheel in place and weld the fork to the frame. Cut the handle bars to 50" and bend them as shown. Miter them to fit the frame and mater the two vertical back braces to fit the handle bars.

The lug shown on the 21" crossbar is bent of %" stock. Drill it 3/16" and weld it I" from the right handle bar. The other lug for the switch-box plate also is %" iron, but has two holes. Weld the box to the frame so that the toggle switch will be in line with the right handle bar. One of the switch-plate screws that holds the switch will also hold the lug. Bend a loop in an end of a %" drill rod. The rod passes through the two lugs and the loop fits over the toggle switch. Put a knob on the handle-bar end of the rod to complete the switch setup.

A 13" square of 16-gauge sheet from, with the four corners cut off to leave 3" diagonal edges, takes the blades. These are the type used on farm mowers. Bolt them to the plate with 3/16" stove bolts and lock washers. Drill a %" hole exactly in the center of the plate for the spindle. Thread an end of the 12" spindle for about 2" to take two 3"-20 flanged nuts that fit on each side of the plate, Drill a hole for a cotter pin in the threaded end. Hold the spindle in the bearing with a " collar. Put a 24" pulley on the spindle and a 2" pulley on the motor.

Cut the motor-mounting board of #" plywood. The board fits between the ribs of the T-trons so it may be moved forward or back. Wing nuts and bolts hold it to the T-irons. With the board and motor as far forward as possible, put on the 30" V-belt. Sliding the board back tightens the belt. Connect the motor to the switch and attach as much

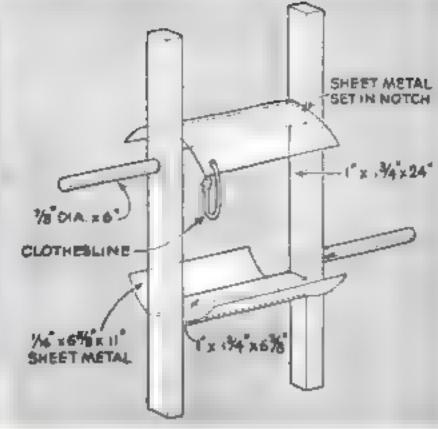
heavy duty cord as you'll need

The cover plate, sides, and back are cut from 24-gauge black iron. Bend down the edges of the cover plate to a good fit. Sides, back, and cover are held to the frame by 3/32" stove bolts. Paint the frame and slip rubber grips on the handle bars.

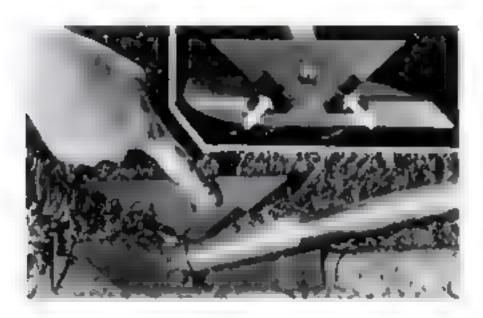


Rect Stores 100' of Hose

HANDLING and stowing garden hose is simplified with this lightweight reel. To wind up the hose, first attach the nozzle by the rope loop. Then rotate the reel as shown in the photo. Of course the dimensions may

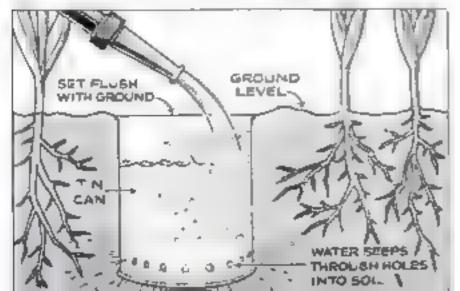


be altered, but remember that the overall length of the reel is limited by the reach of your arms. Instead of the sheet metal indicated in the drawing, you can use old license plates, but file off any sharp edges. The handles can be cut from a shade roller or broomstick.—W. E. Stephens, Belmar, N. J.



Tin Can Waters Plant Roots

Too much water sprinkled on flower beds tends to run the soil particles together, causing it to bake hard afterwards. A large can, with holes punched near the bottom and set flush with the surface of the bed, gets the water down into the soil around the roots where it's needed. The surface soil is left loose.—P. R. Wilson, Brookhin Out



Old Razor Blades Trim Grass

MOUNTED on a 48" handle, this lawn edger holds two single-edge razor blades at opposing 45-deg, angles. A turn of a screw loosens the plate to replace the blades. In use, the flat plate engages the edge of the sidewalk and the edger is pulled or pushed. The triangular vertical plate pulls the grass down under the blades and the pointed sidewalk plate raises the grass. Commercial Mig. Co., Chicago, is the maker.

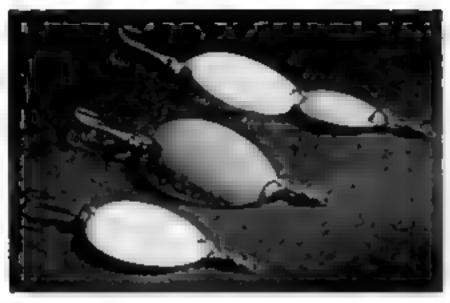
Timing Valve Shuts off Water

SET for the length of time you want the lawn sprinkled, this valve can be left to shot off the water while you go about other busi-

ness. The adjustment at right lets a trickle of water into a cylinder, slowly forcing a piston down into a valve seat to turn off the water to the sprinkler. Opening or closing the adjustment sets the time. Watermiser Co., Belmont, Calif., makes it.



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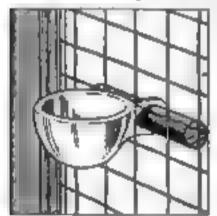


Plastic Spoons Make Lures

Colored fishing lures can be cut from dime-store plastic spoons or tableware. Saw the handle off the spoon and smooth down the bowl part with sandpaper. Then drill holes at each end—one for a link and swivel and the other for a link and hook. The lures shown above are fitted with No. 3 treble hooks. If you use a plastic tumbler or dish, cut out a blank and gently clamp it between two metal spoons. Place the assembly in boiling water and gradually tighten the clamp as the plastic becomes pliable. This will shape it to the spoons. Then sand it and drill it.—A. E. Kurth, Detroit.

Rabbits Feed from Coffee Cup

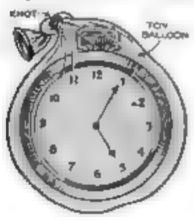
A 10-CENT coffee cup, secured to the wire mesh by a wooden plug through the handle, makes a simple feeder a rabbit can't upset.



Push the handle through a mesh and then insert the plug. Whittle the plug for a tight fit so the cup won't wobble or tend to turn to one side. —George C. Throop, Syracuse, N. Y.

Balloon Waterproofs Watch

You can safely carry your watch on camping and fishing trips if you'll slip it into a toy balloon. Tie the balloon's neck in a



knot to seal it against moisture. A balloon is so thin that it's transparent when stretched tightly, and you can read the face of the watch through the rubber.—R. A. Jenkins, Los Angeles.

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Strainer Retrieves Golf Balls

I MADE a simple, serviceable golf-ball retriever from a small kitchen strainer and a flat, telescoping curtain rod. Carried in my golf bag, it gets balls out of water and from under bushes. Saw the curved ends off the rod and remove the wooden handle from the strainer, leaving the two wires that were inside the wood. Then force the wires into one end of the smaller section of the curtain rod. Crimp the edges of the rod over the wires to lock the strainer in place. Use a painted curtain rod and you won't be bothered by its rusting.—Arthur Trauffer, Council Bluffs, Ia.

Aluminum Strips Scare Pests

CALLED Scare-Away , these specially treated aluminum strips keep birds and small wild animals out of the garden. The strips, 15" long, are hung over the area to be protected. They flutter in the lightest breeze, flashing light and making a tinkling noise. The most common uses of the strips are protection of newly planted seeds, tender sprouts, ripe berries, fruits, and vegetables. The maker is Donaxe Co., Portland, Ore.



New Valve Seats End Faucet Drips

You can stop a dripping faucet with a new washer-sometimes. But if the valve seat is rough or grooved, chances are a new washer is only a temporary cure, and it may not stop the leak at all. Since most faucets today have removable seats, it's easy to change them with this simple tool. New seats can be bought at hardware stores or plumbing shops.

Grand the tool from a 6" section of \$" drill rod or a piece of iron rod the same size. Since drill rod is much tougher, it will give you a more permanent tool. The holes in sents usually come in two standard shapes—hex and square. So grind one end of the rod for a \$" hex hole and the other end for

a 3" square hole.

To use the tool, first shut off the water supply and remove the valve stem. The stem will screw out of the valve body after you've unscrewed the nut just under the faucet handle. On many faucets, the nut, handle, and valve stem come out together. Don't disturb the packing under the locknut.

Now insert the seat-removing tool in place of the stem and use a wrench or pliers on the other end of the tool. Turn it



Two common kinds of removable valve seats are seen here, with square and hex center holes. Homemade tools to remove them are above.

counterclockwise to unserew the old seat.

Ship the new seat on the end of the tool and screw it in place fairly tight, but don't overdo it. Replace the stem, tighten the nut, and the valve is as good as new. While you have the faucet apart, it's a good idea

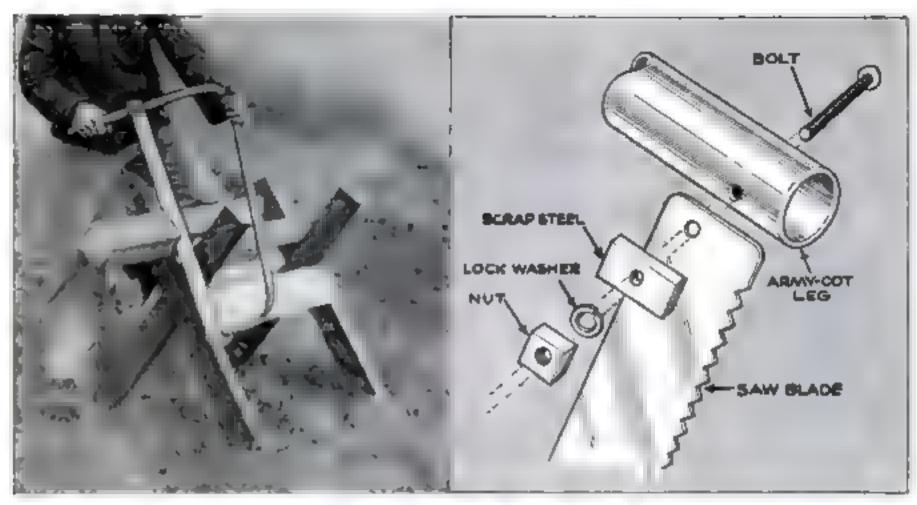
to replace the washer if it's worn.

When a faucet leaks around the stem, it needs new packing. Slide up the nut to add more, or pull out the old and replace it with new. To reset the handle at a convenient angle, remove the top screw, pull off the handle, and replace on the splines as desired.—William E. Danneman, Chicago.



Here are the three steps in replacing a faucet seat. First use a wrench to unscrew the nut under the faucet handle. Then screw the stem out by turning it as you would to let water

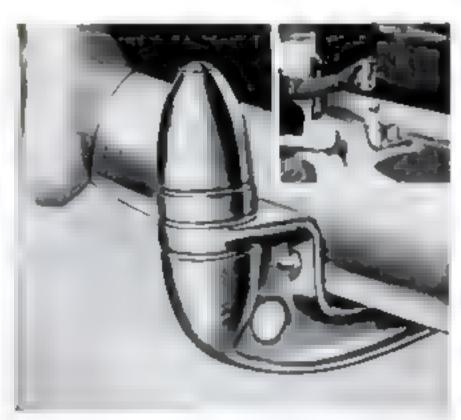
through the faucet. Insert the tool (center photo) and with wrench or pliers, turn it counterclockwise to unserew the seat. Ship a new seat on the tool and thread it in place.



Bucksaw Frame Cut from End of Old Metal Cot

You can make a new frame for your bucksaw by cutting down the end of a metal cot and drilling it to take the blade. I picked up the end of a tubular steel cot at a junkyard. Lay the blade across the frame and mark the hole locations. Then spring the

off one end as shown in the photo and drill X" holes. Fasten the blade on with X" by 1X" stove bolts, using plates cut from scrap to hold it tightly against the frame.—Ralph S. Wilkes, Keuka Park, N. Y.



Trailer Hitch Is Streamlined

MADE of chrome-plated cast steel, the Husky Hitch® exceeds drawbar strength requirements by 12 percent, according to the Altadena Products Corp., Altadena, Calif. The cap of the hitch covers a rustproof ball. Custom designed to fit various makes of cars, the hitch has smooth lines to eliminate soiling or snagging of clothing and danger of injuries from sharp projections. When not in use, it acts as a bumper guard.



Railings Made from Steel Bed

Ornamental hand railings for porches and stairs may be made from the heads of old tubular steel beds. Saw the head in two in the middle and use a half on each side of the steps. The lower ends of the one shown here were set in concrete. The top ends are held in place by blocks screwed to the siding. Holes were bored in the blocks to accommodate the tubing, and the railings were painted.—Mrs. Clare Wilkes, Cato, N. Y.

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Sparkling shight describes the image you see in the finder of the new Kodak Reflex II Camera. Sharper focusing, edge-to-edge composing are made possible with the new Kodak Ektalite Field Lens beneath the ground-glass screen (see diagram above). Microscopic lens grooves redirect stray light rays—give you an image 2% times as bright overall, 10 times as bright at corners, as with the usual ground-glass finder.

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Chess Set Made of Plastic

THESE smooth-lined, artistically formed chessmen should please chess fanciers. Created by Peter Ganine, sculptor and design consultant, they are made of red and black Bakelite® phenolic plastic. The pieces are lightweight and said to be practically non-breakable. A carrying case comes with the set, which is nationally distributed by Zacho, of Los Angeles. In the luxury class, the chessmen retail for about \$75.



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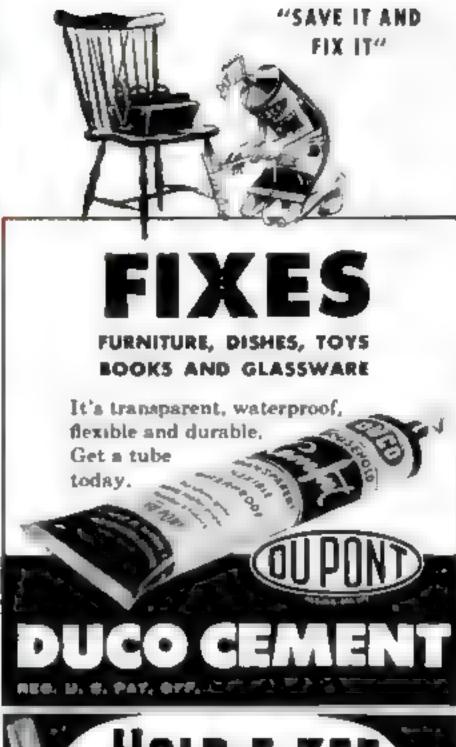
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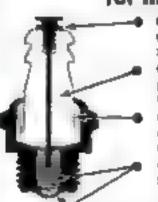






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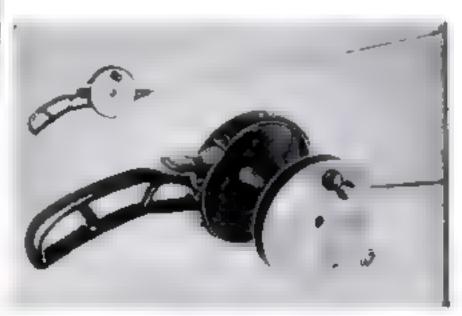
Purolator Refills fit all oil filters. \$1.38 to \$2.50, depending on make of car; installed in a few minutes. If your car is not equipped with an oil filter, put in a Purolator. \$6.50 up, also depending on make of car.





Dispenser Counts Chips

The banker can't make mistakes in handing out chips from this rack with an automatic counting device at the side. He just moves the chips, which are nested in a revolving center section, up to the counter, pushes in a lever at the number of chips he wants to give a player, and lifts them out. Molded of black Bakelite[®], the set has a cover that locks on. Count-Rite Corp., of Cleveland, makes it



Rod Has Gunlike Grip

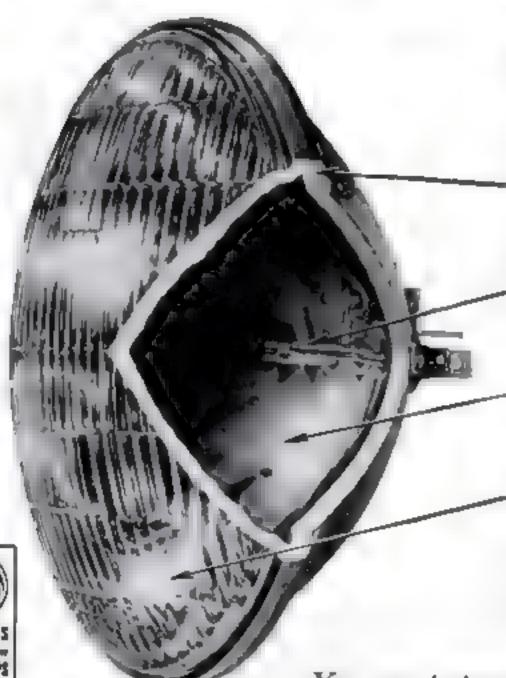
This simple casting rod for novice fishermen has a gun-shaped, cast-aluminum handle with a built-in holder for interchangeable reels. A snap-on reel fastener lets a fisherman quickly change from one line to another. Called the Handy Dandy[®], the rod is oil-tempered and comes in 32-and 44-inch lengths. Made by the Nu-Toy Manufacturing Corp., of Detroit, the rod has a special carrying case.

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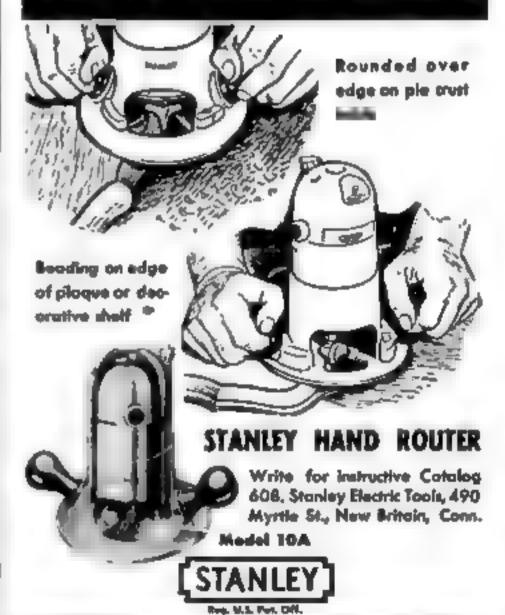
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- 3. A pen-size handpiece for "close control" on fine work.
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- 5. A handy hanger-ring to hold the motor on a hook or overhead pipe.

Doesn't that sound like the perfect tool for hundreds of jobs in any home workshop? And it is. That's why it belongs at the top of your "want" list. Send for complete information.



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- No. 19-921 Hobby Flex, consisting of motor, Sexible-shaft, handpiece, and wrenches, \$21.50 enclosed.
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Panel Tests Auto Lamps

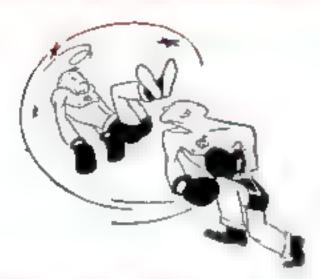
This new device for use in automobileaccessory stores makes it easy for a salesman to give any size of car lamp a final check before wrapping it up for a customer. Five outlets on a single panel, and a six-volt transformer to vary the voltage delivered to them. can handle a complete line of lamps-from a tiny instrument-panel bulb to a scaledbeam headlamp or spotlight. Westinghouse developed the tester.



Radio Does Double Duty

PUNCHING a button on this radio turns it and the extension outlet at the right into a two-way communications system between rooms. Both the master AC-DC radio and desk extension, connected by a 50-ft, cord, have 5-in, speakers that double as microphones. The outfit, called Radio DorAfone®. is made by Setchell Carlson, Inc., of St Paul. The matching cabinets come in black or ivory plastic,

extra punch.



Extra punch when you need it.

When spark plugs become sluggish or misfire under heavy loads, the cause is probably exide pating on the insulators. To minimize or correct this condition, get a set of new AC Spork Plugs with patented CORALOX Insulator.*

They give you easier starting, better idling, and the extra punch you need for hard pulls oc cross-country draving.

They give you the extra mileage that means seal economy. And they stay clean and efficient longer.

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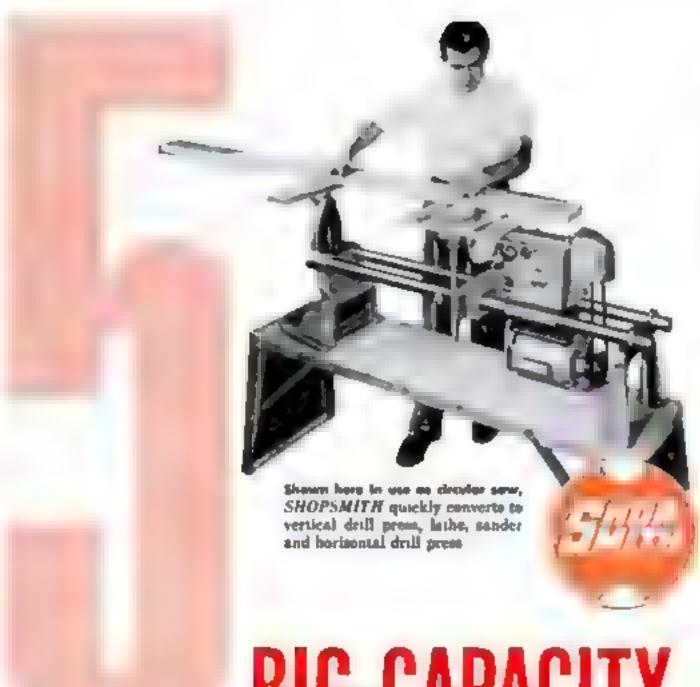
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*AC's patented processes make Coralox the finest insulator in spark plug history, improved electrical insulation, no matter how high the temperature. Better heat conduction. Maximum resistance to heat shock, less fouling. Harder, stronger, longer-leved.





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Quick-converting Shopsmith changes from any one to any other of the five basic power tools shown here in less than a minute. It has greater work capacity in each position than comparable single-purpose tools, Shopsmith converts also to buffer, grinder, router, drum sander, shaper, mortiser, etc.) Shopsmith is precision-engi-

big or small jobs. Ruggedly built—weighs 200 pounds. You can set up a SHOPSMITH in any corner of your basement or garage. See demonstration at any Montgomery Ward store, or your leading hardware or department store, Or mail coupon below for name and address of nearest dealer.

FIVE TOOL UNIT COMPLETE ONLY \$15950

with 1/2 h.p. ball bearing motor \$195.50

MAGNA ENGINEERING CORPORATION

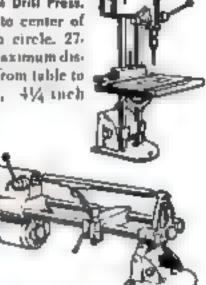
465 California Street—Dept. 24A, San Francisco 4, California Please send descriptive folder on SHOPSMITH and name of nearest dealer

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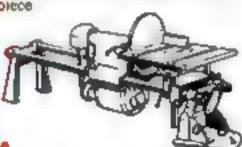


Circular Saw. Depth of cut 21/4".
Table 141/2" x 17"—with extension 54" x 17". Up to 46" between blade and fence, Tilting table

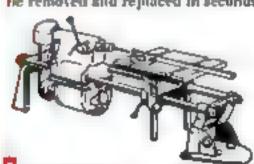
2 shops with me a Vertical Drill fress. Drills to center of 15-inch circle. 27-inch maximum distance from table to chuck, 4½ tuch feed



3 shopsmith us a 24" Wand Lathe, (34" between centers) with a 15-inch swing. Quill feed 4½ inches. Tool rest always slides parallel to work piece



4 SHOPSMITH as a 12" Over Sender. Adjustable mitre gauge, 14½" x 17" table tilts to 45 degrees. Discs conhe removed and replaced in seconds

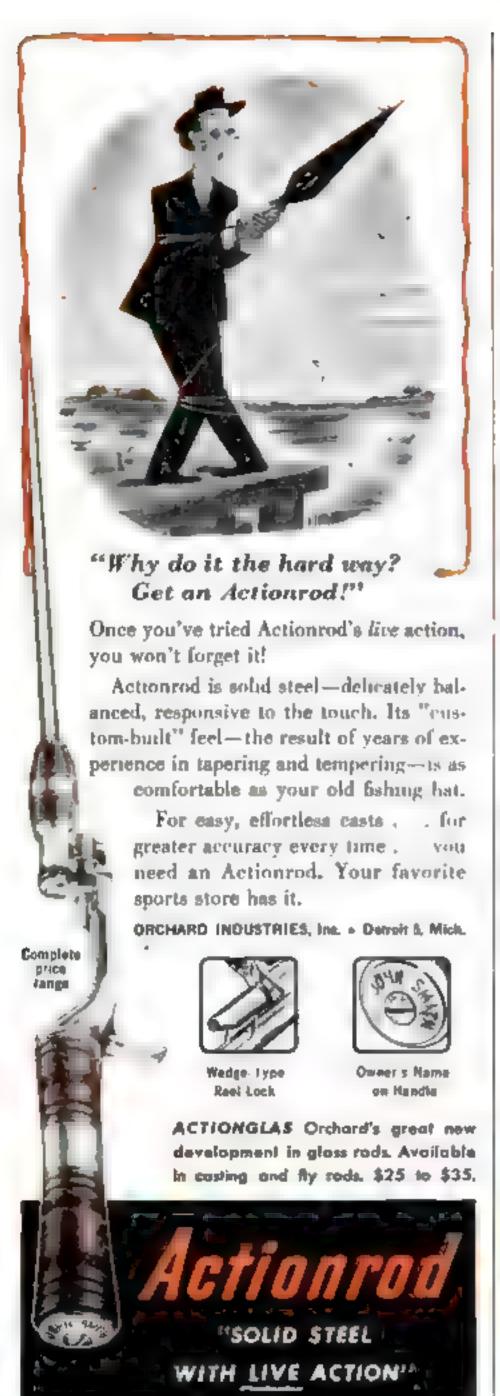


5 SNOPSMITH as a Herisantal Dail Press. Brand-new in the power tool field! Provides accurate drilling for doweling. No limit on length of work

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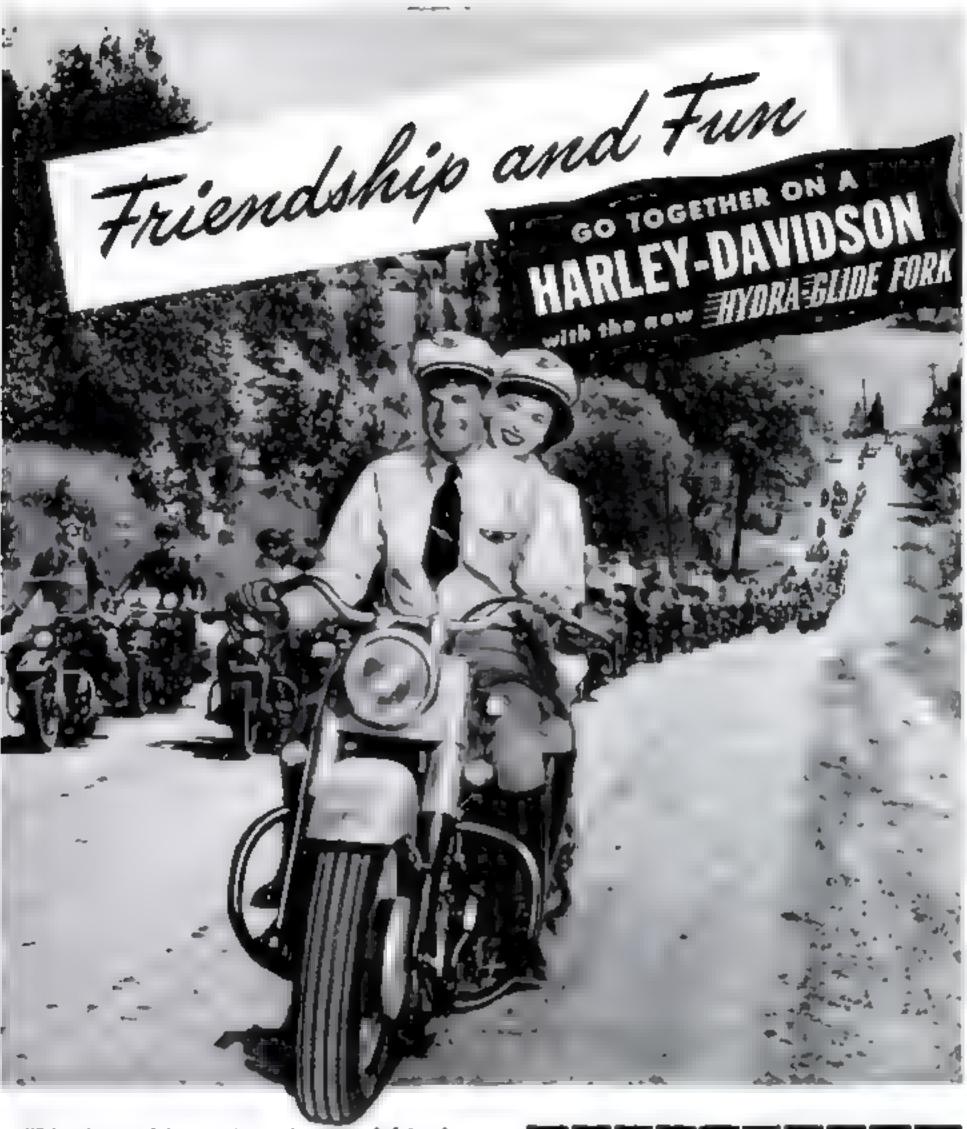
Box Magnifies Sound

This 8%-oz, electronic sound magnifier does for people whose hearing is slightly impaired what eyeglasses do for those who are nearsighted. Called the Hearette®, it is designed to be carried in a pocket or handbag and held to the ear under conditions where the sound level is below that of ordinary conversation. At full blast, though, it's said to increase the power of sound to the ear more than 100,000 times.



Stapling Gun Speeds Wiring

A NEW pistol-grip staple driver, shown above, makes quick work of clipping electrical wiring to baseboards, walls, door jambs, window frames, or rafters. Made by the Heller Co., of Cleveland, the gun has been adopted by the Bell Telephone Systems for installing low-tension lines. Insets show its ammunition—staples in different colors to match the wiring—and how it pushes them into wood or plaster.



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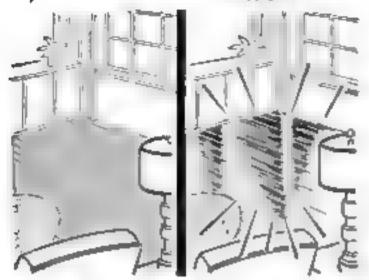
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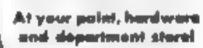
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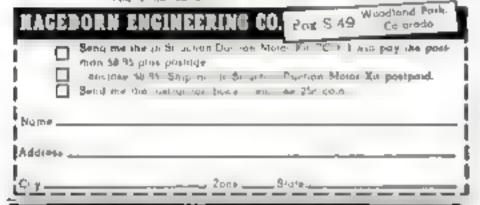
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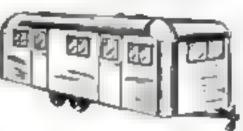
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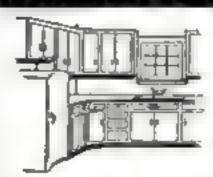


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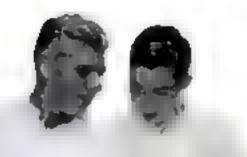
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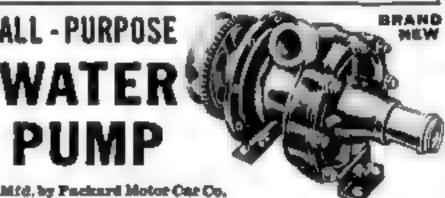
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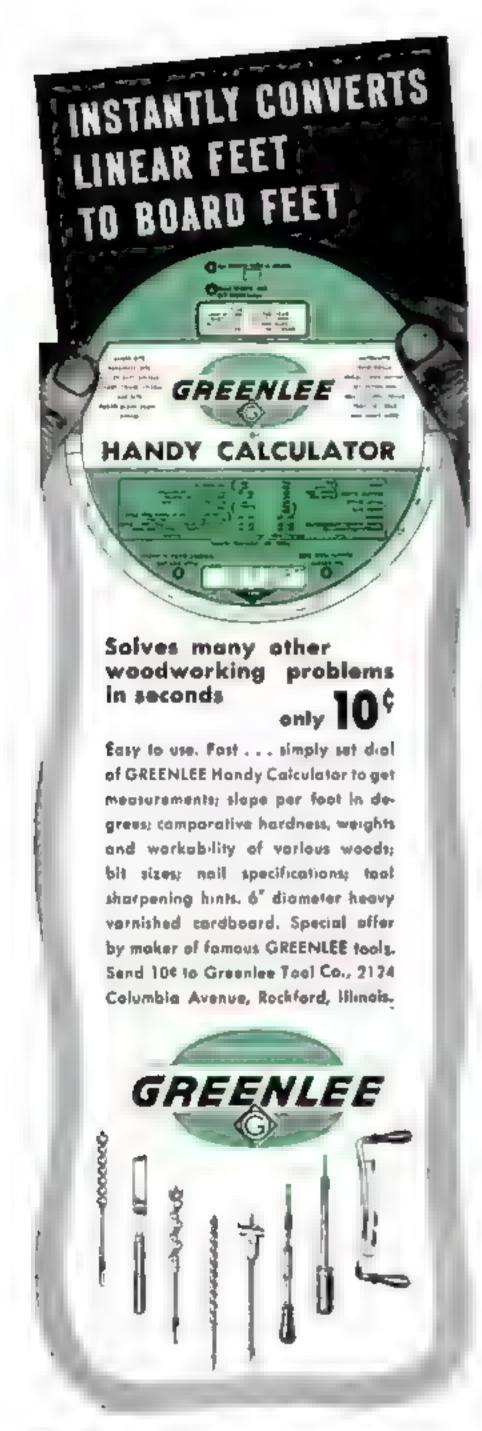
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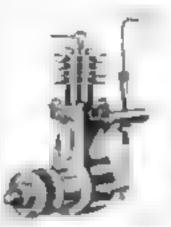
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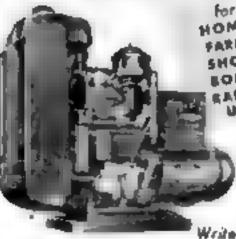
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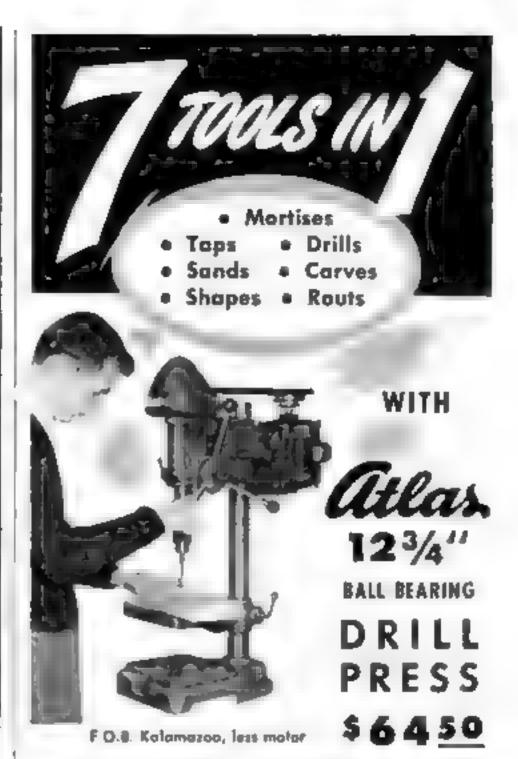
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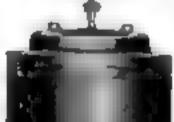


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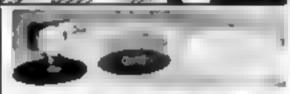
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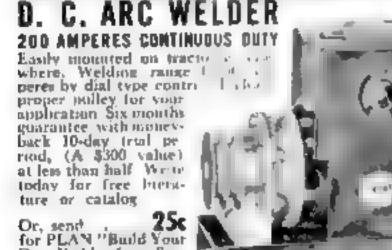
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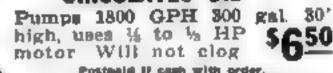
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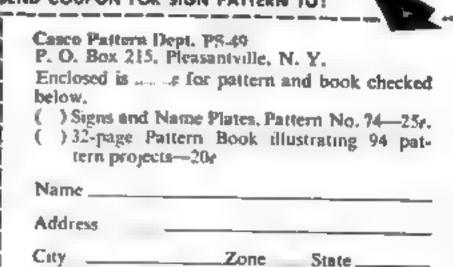


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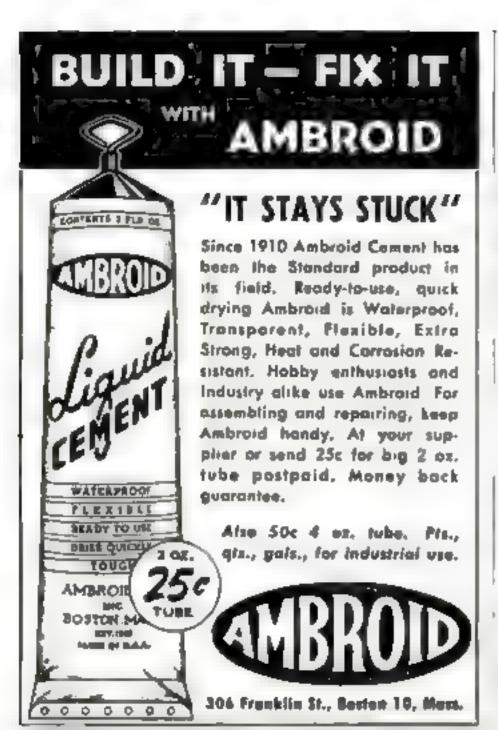
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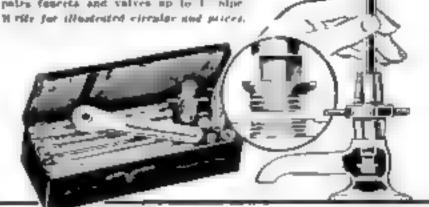


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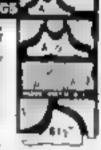
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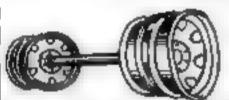
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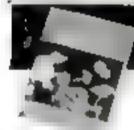
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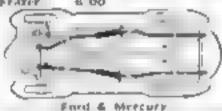
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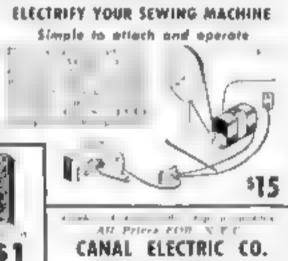
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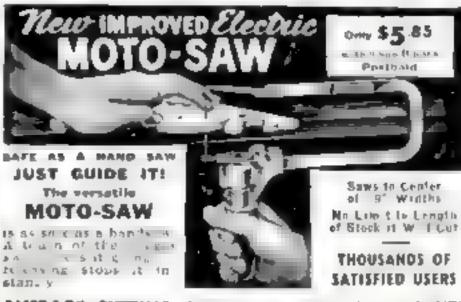
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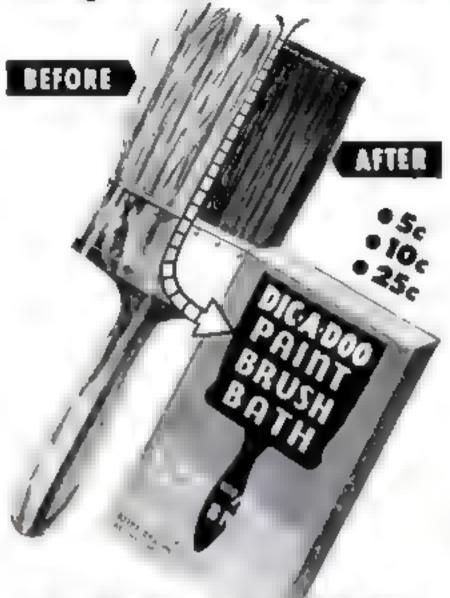
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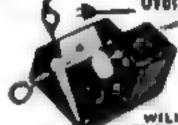
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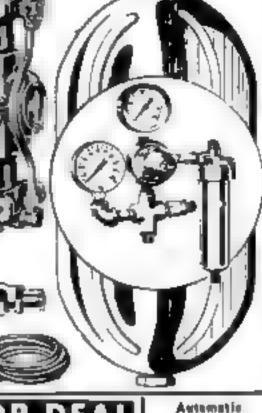
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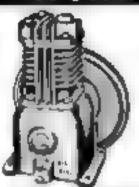
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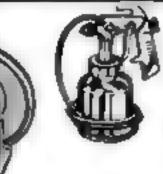
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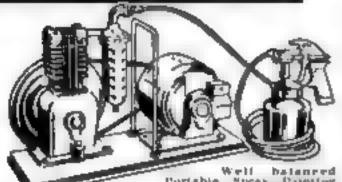


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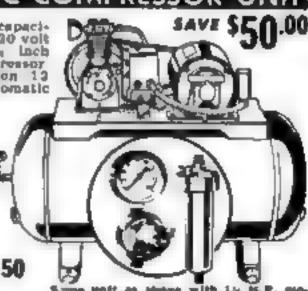
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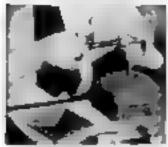


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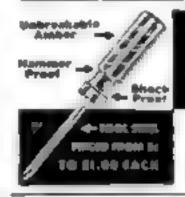
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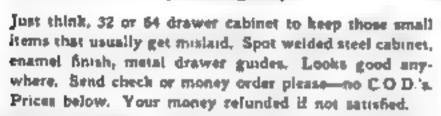
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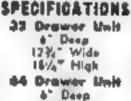
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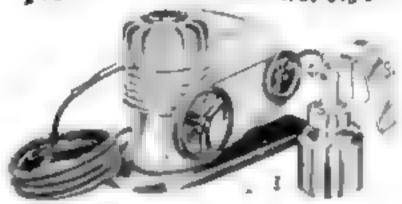
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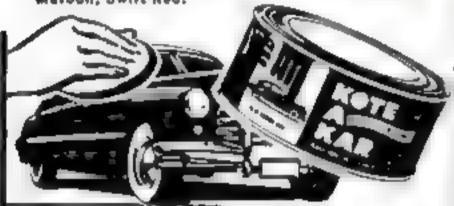
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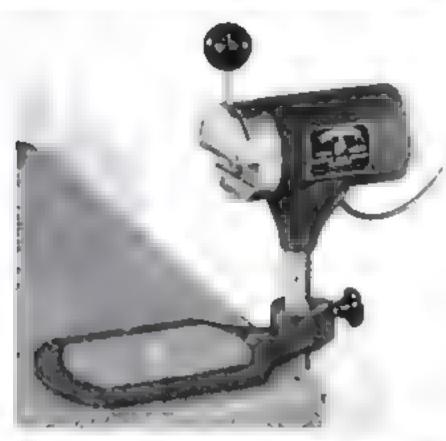


**Kettle Heats Bottles.** The T-Ket-L<sup>®</sup> has an adjustable, triple-action spout that can be converted from a whistle to a dish sprayer to a pouring spout. All you do is turn the insulated knob to the proper setting. Holding a half gallon, the kettle has a water gauge calibrated by cups. Cans and bottles may be heated in the small opening. Excel Manufacturing Co., Muncie, Ind., prices it at about \$4.

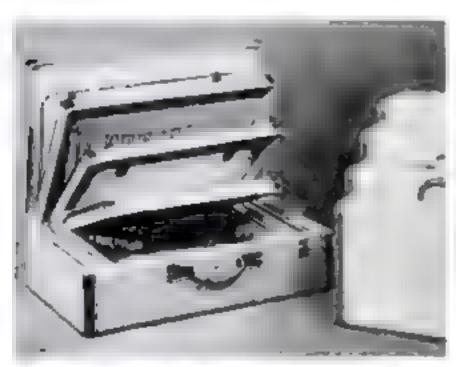


Table-Top Barbeene. The Braziereto turns out charcoal-flavored steaks right at your plate. A handful of standard charcoal briquets furnishes fuel for several hours. Made by S. A. Asquith Co., Los Angeles, it retails for about \$17.

# Modern Living



Motor Powers Can Opener. Driven by an AC-DC motor, this machine opens any container from a sardine tin to a five-gallon can. One motion locks the can in position and starts the motor. Another move of the knob stops the motor and releases the can. A compression spring in the center of the base compensates for rims of badly dented cans. Maker is Strong Appliance Industries, Inc., Danbury, Conn.



Three Bags Stored in One. The largest piece, 29" long, holds three others 21", 24", and 26" in length to save storage space. Made of waterproof canvas bound in cowhide, the set is priced at \$100 by the maker, Brecher Brothers, New York City.



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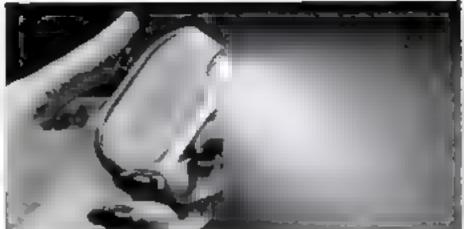
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# Aids to Modern Living



Food Shaver. Built of aluminum and finished in nickel, this shaver slices all kinds of vegetables and also chops nuts. A fine cutter blade is available to crumble dried bread and crackers and to grind up lump chocolate. Manufactured by Work Savers Industries, of Farmington, Mich., the shaver sells for about \$3.50.



Thermometer Built in Spray. Reading from 60 to 160 deg. F., the curved thermometer in the head of the Thermoscopic® spray instantly gives the water temperature, according to the maker, Breau Plastic Industries, Philadelphia, Pa. The head is non-shattering, clear plastic. It comes with 5' of white rubber hose and spigot adapter. The price is about \$4. It's recommended for bathing, shampooing hair, and for laundering fine fabrics,



Masking Tape Is Liquid. You just brush this liquid-based on Vinylite® resins -on the surface to be masked. It dries in about 10 seconds and you're ready to paint. When the paint is dry, the plastic shield can be peeled off like tape. It's priced from 49 cents up, depending on the jar size. Rumsell Products, Maywood, Ill., is the maker.

Tightens Clotheslines. Quik-Tite © tightens and locks a clothesline in one movement. Loop the line over the roller and pull

down to take up the slack. To remove the line, pull down and release the grip. Easy to install, the tightener is made of cadmiumplated steel to resist rust. It's priced at 29 cents by Hall Industries, Inc., Chicago.



Folding Cribbage Board. This plastic board folds up, providing storage

space for a deck of cards and the pegs It's molded of lightweight polystyrene plastic and sold by the Nelson Products Company, of Arlington, N. J.



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# Reader

# Meet a Volunteer Editor



SOME of our ablest editors carry no press cards, sign no stones, and are not listed on the musthead. They are the volunteers, the big-shot executives and hot-shot mechanics who help make POPULAR SCIENCE understandable and authoritative.

Take Bill Barnes, for instance. We had been having some trouble with the over-drive story (see page 180). A well-known technical writer had filed his report. Our staff men had questioned car dealers and their service foremen. The story envelope bulged with manuals, sketches, and photographs. But we weren't getting the answers we wanted.

Then Stewart Rouse (you know his cutaways) flew to the Warner Gear plant in Indiana and reported that a man there named Barnes seemed to know all the answers. After some telephone palayer, we shipped Mr. Barnes a rough script.

The next thing we knew our receptionist was saying, "Mr. Barnes to see you," and there he was. We got our answers, and then some. We got the whole history of overdrive. We were led by the hand through its tricky mechanical principles. Mr. Barnes not only knew his subject, he loved it. And he talked with the enthusiasm of a proud

father. In fact, to hear him talk, you'd think he'd invented the thing!

Well, he did. Bill Barnes holds the basic patents under which some three million of these semiautomatic transmissions have been built. He's the head man of Barnes Motor Developments Co., consulting engineer for Warner Gear, and is known in the industry as the father of overdrive.

This is the man who took time out to come to New York because he wanted PS to get the right answers, and all the answers. He is one of the many authorities on subjects ranging from atom smashing to tire changing who are glad to tell us what they know so that we can tell you.

Bill Barnes is a good example of the hundreds of busy men who spend hours and hours with PS writers, artists, photographers, and editors. Some of them are big brass in the armed services; some are big wheels in science, industry, or government. Some are specialists in less spectacular trades or jobs.

But all of these invisible editors have a common interest: they want to get you the straight dope.

Frank Roman &

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CATALOG 73 describes the new 13"

and 141/1" Quick Change Gear and Tool-

room Lathes with 1" maximum collet capacity; their Attachments, Accessories, Tools.

CATALOG 77-U describes Attachments.

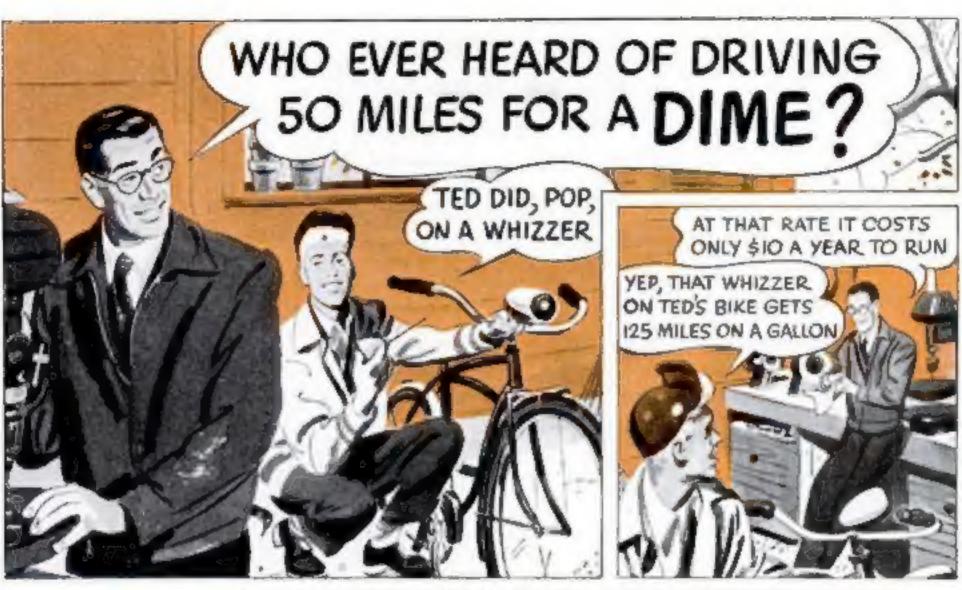
Accessories and Tools for all sizes and

types of South Bend Lathes. Many adapt-

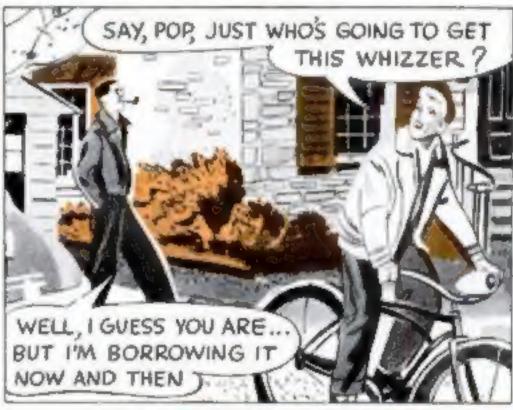
CATALOG 400 describes the new 14"
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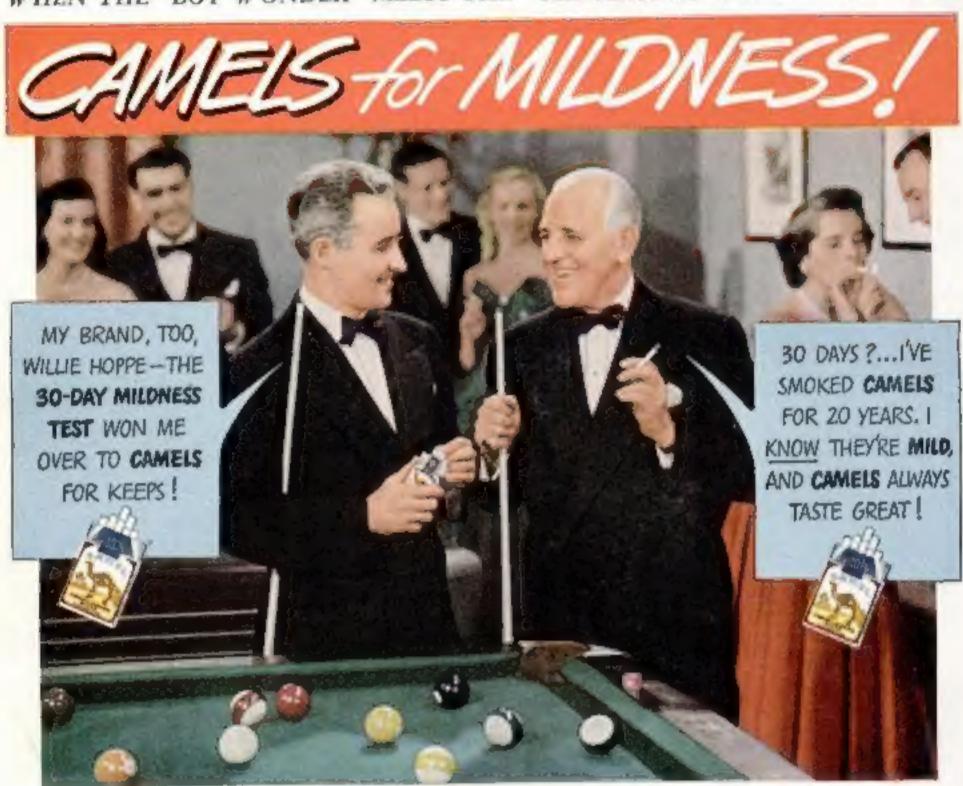
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